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COMMITTEE OF EXPERTS ON THE
TRANSPORT OF DANGEROUS GOODS

Sub-Committee of Experts on the
Transport of Dangerous Goods
(Fourteenth session,
Geneva, 8-18 December 1997,
agenda item 2 (d))

DRAFT AMENDMENTS TO THE MODEL REGULATION ON THE TRANSPORT OF DANGEROUS GOODS

Other draft amendments

Provisions concerning radioactive material

Transmitted by the Expert from United States of America

1. As agreed by the Sub-Committee at its thirteenth session the expert from the United States has undertaken to editorially reorganize the requirements for radioactive materials as found in ST-1 into the model regulation using as a basis the proposal provided by IAEA in ST/SG/AC.10/C.3/1997/33. The revised text is provided in Annex 1. A paragraph by paragraph comparison on the location of IAEA provisions is provided in Annex 2 and a list of consequential amendments is provided in Annex 3.

2. Written comments were also received from the experts from Belgium, Germany, and the United Kingdom and these were taken into account in the preparation of the revised proposal.

3. Major changes include:

(a) Based on comments from the expert from the United Kingdom, the presentation of the radioactive materials requirements was rearranged in a form more consistent with the ICAO Technical Instructions. The Model Regulation was structured after the ICAO Technical Instructions. The arrangement in ICAO more logically distributes the various ST-1 provisions among the the UN Chapters. For example, this led to moving criteria and tests for the various types of radioactive material (e.g., LSA, SCO and special form) into Chapter 2.7 since these provisions were of a classification nature. It was also possible to dispense with inclusion of the IAEA schedules in this manner.

(b) Some provisions from ST-1 were informational in nature (e.g. 101 - 106). Portions of these provisions were placed in the UN Recommendations.

(c) Some provisions, while specific to the transport of radioactive materials in ST-1, could logically be made applicable to all dangerous goods. For example, recommendations on emergency response and compliance assurance were made applicable to the transport of all dangerous goods. Similarly, a provision clarifying signage of the shipper's declaration was made applicable to all dangerous goods.

(d) Some IAEA provisions were administrative in nature (e.g., ST-1 800 series requirements). For example, there are provisions prescribing in great detail the contents of applications for approvals and the contents of competent authority approvals. It was felt that much of this constituted advice to the competent authority and should not be included in the Regulations themselves. These were moved to the Recommendations. However, the expert from the United States believes that the Sub-Committee should at some point consider developing an additional supplementary document (similar to the ICAO Supplement) to the UN Model Regulation which gives advice to Competent Authorities. These provisions should then be included in the supplementary document.

4. The Sub-Committee should note and discuss the following:

(a) **Transport by Post**. ST-1 addresses transport by post (see ST-1 paragraphs 410, 879 and 880). While not explicitly excluded from the Regulations, it has been generally assumed that transport by post, which is subject to the Universal Postal Union Convention, was not covered by the Model Regulation. It is recommended that provisions on transport by post be excluded and that this be clarified by amending paragraph 1.1.1.2 by adding an additional subparagraph stating:

"(d) Dangerous goods transported by the mail which is subject the Universal Postal Union Convention."

(b) **Transitional measures.** Comments received on transitional measures (originally located in Part 1in the IAEA proposal) favored their placement in Chapter 6.4 to which they have been relocated. It should be noted that previously the adoption of transitional measures was left to the various modal authorities. In the future the expert from the United States favors a more coordinated approach on other transitional measures through the UN Regulations.

(c) **New definitions**. It should be noted that some of the ST-1 definitions as written are not specific to radioactive material transport and by adding them to the Regulations they become applicable to the transport of all dangerous goods. These definitions include aircraft, carrier, competent authority, compliance assurance, consignee, consignment, conveyance, defined deck area, freight container, quality assurance programme, shipment, shipper (originally consignor), tank, vehicle and vessel.

5. Further steps could still be taken to assimilate the IAEA provisions into the Regulations. For example, the expert from the United Kingdom noted that some of the general packaging requirements for radioactive materials that currently appear in Chapter 6.4 are similar to general packaging requirements for other dangerous goods found in Part 4.

6. The Sub-Committee is invited to consider the proposals for incorporating Class 7 provisions into the Model Regulations. In order to assimilate the ST-1 provisions into the Model Regulation, numerous editorial revisions were necessary. These are reflected in the document, usually through strike-out and italics. The proposed text should be thoroughly reviewed to ensure that the ST-1 requirements are properly reflected.

* * * * *

Annex 1

IAEA ST-1(1996) INCORPORATED AS NEW CLASS 7 PROVISIONS INTO THE UN RECOMMENDATIONS

IAEA ST-1 paragraph numbers remain in square brackets.

Some complete paragraphs are totally enclosed in square brackets.
The retention, modification or deletion of these paragraphs will be the subject of future discussion.

ST-1 paragraphs modified for compatibility with the UN Recommendations structure are marked additionally with an "M" for example [230M]. In other instances the stikeout feature is used to show text that should be deleted from an IAEA provision and text to be added is shown in italics.

ST-1 paragraph numbers have been retained in square brackets or in strikeout form with new UN paragraphs shown. They should be deleted when the final UN text is agreed. ST-1 references to Sections, Tables and Figures are also shown but should be deleted upon final agreement of the text.

Editorial comment is shown under some provisions.

Recommendations on the Transport of Dangerous Goods

Add the following:

Emergency Response

16 [308.] The *Competent Authority should establish emergency provisions to be taken in* the event of accidents or incidents during the transport of dangerous goods radioactive material, emergency provisions, as established by relevant national and/or international organizations, in order shall be observed to protect persons, property and the environment. *For radioactive materials a*ppropriate guidelines for such provisions are contained in "Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material", Safety Series No. 87[4].

Compliance Assurance

17 [311] The competent authority *should ensure* is responsible for assuring compliance with these Regulations. Means to discharge this responsibility include the establishment and execution of a programme for monitoring the design, manufacture, testing, inspection and maintenance of packaging, *the classification of dangerous goods* special form radioactive material and low dispersible radioactive material, and the preparation, documentation, handling and stowage of packages by consignors *shippers* and carriers, to provide evidence that the provisions of these Regulations are being met in practice.

Transport of Radioactive Materials

18 [101.] These *requirements for the transport of radioactive materials are based on the International Atomic Energy Agency (IAEA) Regulations on the Safe Transport of Radioactive Materials (ST-1)* Regulations. *They* establish standards of safety which provide an acceptable level of control of the radiation, criticality and thermal hazards to persons, property and the environment that are associated with the transport of radioactive material. These Regulations utilize the principles set forth in both the "Radiation Protection and the Safety of Radiation Sources", IAEA Safety Series No. 120 and the "International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources", IAEA Safety Series No. 115 , jointly sponsored by the Food and Agriculture Organization of the United Nations, the IAEA, the International Labour Organisation, the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development, the Pan American Health Organization and the World Health Organization. Thus, compliance with these Regulations is deemed to satisfy the principles of the Basic Safety Standards in respect of transport.

19 [104.] The objective of these *requirements* Regulations is to protect persons, property and the environment from the effects of radiation during the transport of radioactive material. This protection is achieved by requiring:

(a) containment of the radioactive contents;
(b) control of external radiation levels;
(c) prevention of criticality; and
(d) prevention of damage caused by heat.

These requirements are satisfied firstly by applying a graded approach to contents limits for packages and conveyances and to performance standards applied to package designs depending upon the hazard of the radioactive contents. Secondly, they are satisfied by imposing requirements on the design and operation of packages and on the maintenance of packagings, including a consideration of the nature of the radioactive contents. Finally, they are satisfied by requiring administrative controls including, where appropriate, approval by competent authorities.

20 The Competent Authority should ensure that the consignment, acceptance for transport and transport of radioactive materials is subject to a Radiation Protection Programme as described in the Model Regulations. [304.] The relevant competent authority shall should arrange for periodic assessments of the radiation doses to persons due to the transport of radioactive material, to ensure that the system of protection and safety complies with the Basic Safety Standards [2].

Applications for Approval and Approvals for Radioactive Material Transport

21 The requirements for transporting radioactive materials in accordance with these Regulations require that certain aspects of the transportation be approved by the Competent Authority through the issuance of approval certificates (also referred to as Competent Authority Approval Certificates). [827.] Five types of approval certificates may be issued: special form radioactive material, low dispersible radioactive material, special arrangement, shipment and package design. The package design and shipment approval certificates may be combined into a single certificate. *The contents of applications for approval and the contents of competent authoriry approvals are described in the following paragraphs.*

22 [822.] An application for shipment approval shall *should* include:

(a) the period of time, related to the shipment, for which the approval is sought;
(b) the actual radioactive contents, the expected modes of transport, the type of conveyance, and the probable or proposed route; and
(c) the details of how the precautions and administrative or operational controls, referred to in the package design approval certificates issued under paras 808, 811 and 814, are to be put into effect.

23 [825.] An application for approval of shipments under special arrangement shall *should* include all the information necessary to satisfy the competent authority that the overall level of safety in transport is at least equivalent to that which would be provided if all the applicable requirements of these Regulations had been met. The application shall *should* also include:

(a) A statement of the respects in which, and of the reasons why, the consignment cannot be made in full accordance with the applicable requirements; and
(b) A statement of any special precautions or special administrative or operational controls which are to be employed during transport to compensate for the failure to meet the applicable requirements.

24 [807.] An application for *package* approval shall *should* include:

(a) a detailed description of the proposed radioactive contents with reference to their physical and chemical states and the nature of the radiation emitted;
(b) a detailed statement of the design, including complete engineering drawings and schedules of materials and methods of manufacture;
(c) a statement of the tests which have been done and their results, or evidence based on calculative methods or other evidence that the design is adequate to meet the applicable requirements;
(d) the proposed operating and maintenance instructions for the use of the packaging;
(e) if the package is designed to have a maximum normal operating pressure in excess of 100 kPa gauge, a specification of the materials of manufacture of the containment system, the samples to be taken, and the tests to be made;
(f) where the proposed radioactive contents are irradiated fuel, the applicant shall state and justify any assumption in the safety analysis relating to the characteristics of the fuel and for *irradiated fissile nuclear fuel* describe any pre-shipment measurement required by para. 674(b);
(g) any special stowage provisions necessary to ensure the safe dissipation of heat from the package considering the various modes of transport to be used and type of conveyance or freight container;
(h) a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package; and
(i) a specification of the applicable quality assurance programme as required in para. 310.

25 [810.] An application for approval of a Type B(M) package design shall *should* include, in addition to the *general* information required *for package approval* in para. 807 for Type B(U) packages:

(a) a list of the requirements specified in paras 637, 653, 654 and 657-664 with which the package does not conform;
(b) any proposed supplementary operational controls to be applied during transport not regularly provided for in these Regulations, but which are necessary to ensure the safety of the package or to compensate for the deficiencies listed in (a) above;
(c) a statement relative to any restrictions on the mode of transport and to any special loading, carriage, unloading or handling procedures; and
(d) the range of ambient conditions (temperature, solar radiation) which are expected to be encountered during transport and which have been taken into account in the design.

26 [805(b)] The application for approval *of designs for packages containing 0.1 kg or more of uranium hexafluoride* shall *should* include all information necessary to satisfy the competent authority that the design meets the *applicable* requirements of para. 629, and a specification of the applicable quality assurance programme as required in para. 310;.

27 [813.] An application for a *fissile package* approval shall *should* include all information necessary to satisfy the competent authority that the design meets the *applicable* requirements of para. 671, and a specification of the applicable quality assurance programme as required in para. 310.

28 [803.] An application for approval of The design for special form radioactive material shall require unilateral approval. The *and* design for low dispersible radioactive material shall require multilateral approval. In both cases, an application for approval shall *should* include:

(a) a detailed description of the radioactive material or, if a capsule, the contents; particular reference shall be made to both physical and chemical states;
(b) a detailed statement of the design of any capsule to be used;
(c) a statement of the tests which have been done and their results, or evidence based on calculative methods to show that the radioactive material is capable of meeting the performance standards, or other evidence that the special form radioactive material or low dispersible radioactive material meets the applicable requirements of these Regulations;
(d) a specification of the applicable quality assurance programme as required in para. 310; and
(e) any proposed pre-shipment actions for use in the consignment of special form radioactive material or low dispersible radioactive material.

29 [828.] Each approval certificate issued by a competent authority shall *should* be assigned an identification mark. The mark shall *should* be of the following generalized type:

VRI/Number/Type Code

(a) Except as provided in para. 30 829(b), VRI represents the international vehicle registration identification code of the country issuing the certificate.
(b) The number shall *should* be assigned by the competent authority, and shall *should* be unique and specific with regard to the particular design or shipment. The shipment approval identification mark shall *should* be clearly related to the design approval identification mark.
(c) The following type codes shall *should* be used in the order listed to indicate the types of approval certificates issued:

AF	Type A package design for fissile material
B(U)	Type B(U) package design [B(U)F if for fissile material]
B(M)	Type B(M) package design [B(M)F if for fissile material]
C	Type C package design [CF if for fissile material]
IF	Industrial package design for fissile material
S	Special form radioactive material
LD	Low dispersible radioactive material
T	Shipment
X	Special arrangement.

In the case of package designs for non-fissile or fissile excepted uranium hexafluoride, where none of the above codes apply, then the following type codes shall *should* be used:

H(U) Unilateral approval
H(M) Multilateral approval

(d) For package design and special form radioactive material approval certificates, other than those issued under *transitional packaging* the provisions of paras 816-818, and for low dispersible radioactive material approval certificates, the symbols "-96"shall *should* be added to the type code.

30 [829.] These type codes shall *should* be applied as follows:

(a) Each certificate and each package shall *should* bear the appropriate identification mark, comprising the symbols prescribed in para. 29 828(a), (b), (c) and (d) above, except that, for packages, only the applicable design type codes including, if applicable, the symbols '-96', shall *should* appear following the second stroke, that is, the 'T' or 'X'shall *should* not appear in the identification marking on the package. Where the design approval and shipment approval are combined, the applicable type codes do not need to be repeated. For example:

A/132/B(M)F-96:	A Type B(M) package design approved for fissile material, requiring multilateral approval, for which the competent authority of Austria has assigned the design number 132 (to be marked on both the package and on the package design approval certificate);
A/132/B(M)F-96T:	The shipment approval issued for a package bearing the identification mark elaborated above (to be marked on the certificate only);
A/137/X:	A special arrangement approval issued by the competent authority of Austria, to which the number 137 has been assigned (to be marked on the certificate only);
A/139/IF-96:	An Industrial package design for fissile material approved by the competent authority of Austria, to which package design number 139 has been assigned (to be marked on both the package and on the package design approval certificate); and
A/145/H(U)-96:	A package design for fissile excepted uranium hexafluoride approved by the competent authority of Austria, to which package design number 145 has been assigned (to be marked on both the package and on the package design approval certificate).

(b) Where multilateral approval is effected by validation *of the original certificate issued by the competent authority* according to para. 834, only the identification mark issued by the country of origin of the design or shipment shall *should* be used. Where multilateral approval is effected by issue of certificates by successive countries, each certificate shall *should* bear the appropriate identification mark and the package whose design was so approved shall *should* bear all appropriate identification marks.
For example:

A/132/B(M)F-96
CH/28/B(M)F-96

would be the identification mark of a package which was originally approved by Austria and was subsequently approved, by separate certificate, by Switzerland. Additional identification marks would be tabulated in a similar manner on the package.

(c) The revision of a certificate shall *should* be indicated by a parenthetical expression following the identification mark on the certificate. For example, A/132/B(M)F-96(Rev.2) would indicate revision 2 of the Austrian package design approval certificate; or A/132/B(M)F-96(Rev.0) would indicate the original issuance of the Austrian package design approval certificate. For original issuances, the parenthetical entry is optional and other words such as 'original issuance' may also be used in place of 'Rev.0'. Certificate revision numbers may only be issued by the country issuing the original approval certificate.

(d) Additional symbols (as may be necessitated by national requirements) may be added in brackets to the end of the identification mark; for example, A/132/B(M)F-96(SP503).

(e) It is not necessary to alter the identification mark on the packaging each time that a revision to the design certificate is made. Such re-marking shall *should* be required only in those cases where the revision to the package design certificate involves a change in the letter type codes for the package design following the second stroke.

31 [830.] Each approval certificate issued by a competent authority for special form radioactive material or low dispersible radioactive material shall *should* include the following information:

(a) Type of certificate.
(b) The competent authority identification mark.
(c) The issue date and an expiry date.
(d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the special form radioactive material or low dispersible radioactive material is approved.
(e) The identification of the special form radioactive material or low dispersible radioactive material.
(f) A description of the special form radioactive material or low dispersible radioactive material.
(g) Design specifications for the special form radioactive material or low dispersible radioactive material which may include references to drawings.
(h) A specification of the radioactive contents which includes the activities involved and which may include the physical and chemical form.
(i) A specification of the applicable quality assurance programme as required in para. 310.
(j) Reference to information provided by the applicant relating to specific actions to be taken prior to shipment.
(k) If deemed appropriate by the competent authority, reference to the identity of the applicant.
(l) Signature and identification of the certifying official.

32 [831.] Each approval certificate issued by a competent authority for a special arrangement shall *should* include the following information:

(a) Type of certificate.
(b) The competent authority identification mark.
(c) The issue date and an expiry date.
(d) Mode(s) of transport.
(e) Any restrictions on the modes of transport, type of conveyance, freight container, and any necessary routing instructions.
(f) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the special arrangement is approved.
(g) The following statement:
"This certificate does not relieve the consignor *shipper* from compliance with any requirement of the government of any country through or into which the package will be transported."

(h) References to certificates for alternative radioactive contents, other competent authority validation, or additional technical data or information, as deemed appropriate by the competent authority.

(i) Description of the packaging by a reference to the drawings or a specification of the design. If deemed appropriate by the competent authority, a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package should also be provided, accompanied by a brief description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance.

(j) A specification of the authorized radioactive contents, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall *should* include the physical and chemical forms, the activities involved (including those of the various isotopes, if appropriate), amounts in grams (for fissile material), and whether special form radioactive material or low dispersible radioactive material, if applicable.

(k) Additionally, for packages of fissile material:

(i) a detailed description of the authorized radioactive contents;

(ii) the value of the criticality safety index;

(iii) reference to the documentation that demonstrates the criticality safety of the contents;

(iv) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;

(v) any allowance (based on para. 674(b)) for a change in neutron multiplication assumed in the criticality assessment as a result of actual irradiation experience; and

(vi) the ambient temperature range for which the special arrangement has been approved.

(l) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat.

(m) If deemed appropriate by the competent authority, reasons for the special arrangement.

(n) Description of the compensatory measures to be applied as a result of the shipment being under special arrangement.

(o) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to the shipment.

(p) A statement regarding the ambient conditions assumed for purposes of design if these are not in accordance with those specified in paras 653, 654 and 664, as *the* applicable *requirements*.

(q) Any emergency arrangements deemed necessary by the competent authority.

(r) A specification of the applicable quality assurance programme as required in para. 310.

(s) If deemed appropriate by the competent authority, reference to the identity of the applicant and to the identity of the carrier.

(t) Signature and identification of the certifying official.

33 [832.] Each approval certificate for a shipment issued by a competent authority shall *should* include the following information:

(a) Type of certificate.

(b) The competent authority identification mark(s).

(c) The issue date and an expiry date.

(d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the shipment is approved.

(e) Any restrictions on the modes of transport, type of conveyance, freight container, and any necessary routeing instructions.

(f) The following statement;

"This certificate does not relieve the consignor *shipper* from compliance with any requirement of the government of any country through or into which the package will be transported."

(g) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat or maintenance of criticality safety.

(i) Reference to the applicable design approval certificate(s).
(j) A specification of the actual radioactive contents, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall *should* include the physical and chemical forms, the total activities involved (including those of the various isotopes, if appropriate), amounts in grams (for fissile material), and whether special form radioactive material or low dispersible radioactive material, if applicable .
(k) Any emergency arrangements deemed necessary by the competent authority.
(l) A specification of the applicable quality assurance programme as required in para. 310.
(m) If deemed appropriate by the competent authority, reference to the identity of the applicant.
(n) Signature and identification of the certifying official.

34 [833.] Each approval certificate of the design of a package issued by a competent authority shall *should* include the following information:
(a) Type of certificate.
(b) The competent authority identification mark.
(c) The issue date and an expiry date.
(d) Any restriction on the modes of transport, if appropriate.
(e) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the design is approved.
(f) The following statement:
"This certificate does not relieve the consignor *shipper* from compliance with any requirement of the government of any country through or into which the package will be transported."

(g) References to certificates for alternative radioactive contents, other competent authority validation, or additional technical data or information, as deemed appropriate by the competent authority.
(h) A statement authorizing shipment where shipment approval is required under para. 820, if deemed appropriate.
(i) Identification of the packaging.
(j) Description of the packaging by a reference to the drawings or specification of the design. If deemed appropriate by the competent authority, a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package should also be provided, accompanied by a brief description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance.
(k) Specification of the design by reference to the drawings.
(l) A specification of the authorized radioactive content, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall *should* include the physical and chemical forms, the activities involved (including those of the various isotopes, if appropriate), amounts in grams (for fissile material), and whether special form radioactive material or low dispersible radioactive material, if applicable.
(m) Additionally, for packages of fissile material:
  (i) a detailed description of the authorized radioactive contents;
  (ii) the value of the criticality safety index;
  (iii) reference to the documentation that demonstrates the criticality safety of the contents;
  (iv) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;
  (v) any allowance (based on para. 674(b)) for a change in neutron multiplication assumed in the criticality assessment as a result of actual irradiation experience; and
  (vi) the ambient temperature range for which the package design has been approved.
(n) For Type B(M) packages, a statement specifying those *applicable packaging* prescriptions of paras 637, 653, 654 and 657-664 with which the package does not conform and any amplifying information which may be useful to other competent authorities.
(o) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat.
(p) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to shipment.

(q) A statement regarding the ambient conditions assumed for purposes of design if these are not in accordance with those specified in paras 653, 654 and 664, as *the* applicable *requirements*.
(r) A specification of the applicable quality assurance programme as required in para. 310.
(s) Any emergency arrangements deemed necessary by the competent authority.
(t) If deemed appropriate by the competent authority, reference to the identity of the applicant.
(u) Signature and identification of the certifying official.

35 [819.] The competent authority shall be informed of the serial number of each packaging manufactured to a design approved *approval* under paras 806, 809, 812, and 816-817. The competent authority should, consistent with para. 311, maintain a register of such serial numbers.

36 [834.] Multilateral approval may be by validation of the original certificate issued by the competent authority of the country of origin of the design or shipment. Such validation may take the form of an endorsement on the original certificate or the issuance of a separate endorsement, annex, supplement, etc., by the competent authority of the country through or into which the shipment is made.

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PART 1 General provisions, definitions and training

1.1 General Provisions

1.1.1 Scope & Application

1.1.2 Transport of Radioactive Material

1.1.2.1 Radiation Protection Programme

1.1.2.1.1 [234.] *The consignment, acceptance for transport and transport of radioactive materials shall be subject to a Radiation Protection Programme acceptable to the competent authority. The programme shall consist of* mean systematic arrangements which are aimed at providing adequate consideration of radiation protection measures.

1.1.2.1.2 [301.] A Radiation Protection Programme shall be established for the transport of radioactive material. The nature and extent of the measures to be employed in the programme shall be related to the magnitude and likelihood of radiation exposures. The programme shall incorporate the requirements *given be.ow* of paras 302-303 and 305-309. Programme documents shall be available, on request, for inspection by the relevant competent authority.

1.1.2.1.3 [302.] In transport, *P*rotection and safety shall be optimized in order that the magnitude of individual doses, the number of persons exposed, and the likelihood of incurring exposure shall be kept as low as reasonably achievable, economic and social factors being taken into account, and doses to persons shall be below the relevant dose limits. A structured and systematic approach shall be adopted and shall include consideration of the interfaces between transport and other activities.

1.1.2.1.4 [303.] Workers shall receive appropriate training concerning the radiation hazards involved and the precautions to be observed in order to ensure restriction of their exposure and that of other persons who might be affected by their actions.

1.1.2.1.6 [305.] For occupational exposures arising from transport activities, where it is assessed that the effective dose:

(a) is most unlikely to exceed 1 mSv in a year, neither special work patterns nor detailed monitoring nor dose assessment programmes nor individual record keeping shall be required;
(b) is likely to be between 1 and 6 mSv in a year, a dose assessment programme via work place monitoring or individual monitoring shall be conducted;
(c) is likely to exceed 6 mSv in a year, individual monitoring shall be conducted.

When individual monitoring or work place monitoring is conducted, appropriate records shall be kept.

1.1.2.2 Quality assurance

1.1.2.2.1 [310.] Quality assurance programmes based on international, national or other standards acceptable to the competent authority shall be established and implemented for the design, manufacture, testing, documentation, use, maintenance and inspection of all special form radioactive material, low dispersible radioactive material and packages and for transport and in-transit storage operations to ensure compliance with the relevant provisions of these Regulations. Certification that the design specification has been fully implemented shall be available to the competent authority. The manufacturer, consignor *shipper* or user shall be prepared to provide facilities for competent authority inspection during manufacture and use and to demonstrate to any cognizant competent authority that:

(a) the manufacturing methods and materials used are in accordance with the approved design specifications; and

(b) all packagings are periodically inspected and, as necessary, repaired and maintained in good condition so that they continue to comply with all relevant requirements and specifications, even after repeated use.

Where competent authority approval is required, such approval shall take into account and be contingent upon the adequacy of the quality assurance programme.

1.1.2.3 Special Arrangement

1.1.2.3.1 [238.] Special arrangement shall mean those provisions, approved by the competent authority, under which consignments which do not satisfy all the applicable *radioactive materials* requirements of these Regulations may be transported.

1.1.2.3.2 [312.] Consignments for which conformity with the other provisions of these Regulations is impracticable shall not be transported except under special arrangement. Provided the competent authority is satisfied that conformity with the other provisions of these Regulations is impracticable and that the requisite standards of safety established by these Regulations have been demonstrated through means alternative to the other provisions, the competent authority may approve special arrangement transport operations for single or a planned series of multiple consignments. The overall level of safety in transport shall be at least equivalent to that which would be provided if all the applicable requirements had been met. For international consignments of this type, multilateral approval shall be required.

1.2.1 Definitions

2.7.4.2 Aircraft

[202.] Cargo aircraft shall mean any aircraft, other than a passenger aircraft, which is carrying goods or property.

[203.] Passenger aircraft shall mean an aircraft that carries any person other than a crew member, a carrier's employee in an official capacity, an authorized representative of an appropriate national authority, or a person accompanying a consignment.]

[206.] *Carrier* shall mean any person, organization or government undertaking the carriage of *dangerous goods* radioactive material by any means of transport. The term includes both carriers for hire or reward (known as common or contract carriers in some countries) and carriers on own account (known as private carriers in some countries).

[207.] *Competent authority* ~~shall mean any national or international regulatory body or authority designated or otherwise recognized as such for any purpose in connection with these Regulations~~. *means a national regulatory body responsible under its national law for the control or regulation of a particular aspect of the transport of dangerous goods.*

[208.] *Compliance assurance* shall mean a systematic programme of measures applied by a competent authority which is aimed at ensuring that the provisions of these Regulations are met in practice.

[210.] *Consignee* shall mean any person, organization or government which receives a consignment.

[211.] *Consignment* shall mean any package or packages, or load of *dangerous goods* radioactive material, presented by a ~~consignor~~ *shipper* for transport.

[217.] *Conveyance* shall mean

(a) for transport by road or rail: any vehicle,
(b) for transport by water: any vessel, or any hold, compartment, or defined deck area of a vessel, and
(c) for transport by air: any aircraft.

[219.] *Defined deck area* shall mean the area, of the weather deck of a vessel, or of a vehicle deck of a roll-on/roll-off ship or a ferry, which is allocated for the stowage of radioactive material.

[223.] *Freight container* shall mean an article of transport equipment designed to facilitate the transport of goods, either packaged or unpackaged, by one or more modes of transport without intermediate reloading. It shall be of a permanent enclosed character, rigid and strong enough for repeated use, and must be fitted with devices facilitating its handling, particularly in transfer between conveyances and from one mode of transport to another. A small freight container is that which has either any overall outer dimension less than 1.5 m, or an internal volume of not more than 3 m^3. Any other freight container is considered to be a large freight container.

[224M.] *Intermediate Bulk Container (IBC)*
Revise the existing definition for *Intermediate Bulk Containers* by adding a new (a)(iv) to read as follows:

"(iv) not more than 3.0 m^3 for radioactive material of Class 7,"

[232.] *Quality assurance programme* shall mean a systematic programme of controls and inspections applied by any organization or body ~~involved in the transport of radioactive material~~ which is aimed at providing adequate confidence that the standard of safety prescribed in these Regulations is achieved in practice.

Under the definition of packagings add the following:

"Note.- For the definition of packagings for radioactive material, see 6.4.1."

[237.] *Shipment* shall mean the specific movement of a consignment from origin to destination.

[212.] *Consignor Shipper* shall mean any person, organization or government which prepares a consignment for transport, and is named as ~~consignor~~ *shipper* in the transport documents.
Editor's note: The UN Regulations and ICAO both use the term shipper in lieu of the term consignor. Recommend that consignor be replaced with shipper throughout.

[242.] *Tank* shall mean a ~~tank container~~, a portable tank *(including a tank container)*, a road tank vehicle, a rail tank wagon or a receptacle with a capacity of not less than 450 litres to contain *solids, liquids, or liquefied gases* ~~and powders, granules, slurries or solids which are loaded as gas or liquid and subsequently solidified~~, and of not less than 1000 litres to contain gases. ~~A tank container shall be capable of being carried on land or on sea and of being loaded and discharged without the need of removal of its structural equipment, shall possess stabilizing members and tie-down attachments external to the shell, and shall be capable of being lifted when full.~~

Editor's Note: The ST-1 definition of a tank container coincides with the UN definition of a portable tank. For this reason the text defining tank container was deleted from the tank definition and a parenthetical was added to clarify that a tank container is a type of portable tank. IMO, ADR/RID use a limit of 1000 litres capacity for gas receptacles. Replaced "tank container" with "portable tank" where it appears (see 625 and 626).

[247.] *Vehicle* shall mean a road vehicle (including an articulated vehicle, i.e. a tractor and semi-trailer combination) or railroad car or railway wagon. Each trailer shall be considered as a separate vehicle.

[248.] *Vessel* shall mean any seagoing vessel or inland waterway craft used for carrying cargo.

PART 2
Classification

PART 2 Classification

Renumber existing para in 2.0.3 as 2.0.3.1

2.0.3.2 [507.] In addition to the radioactive and fissile properties, any other dangerous properties of the contents of the package, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness, shall be taken into account in the packing, labelling, marking, placarding, storage and transport in order to be in compliance with the relevant transport regulations for dangerous goods of each of the countries through or into which the materials will be transported, and, where applicable, with the regulations of the cognizant transport organizations, as well as these Regulations. Radioactive material having other hazardous properties must always be classified in Class 7 and the greatest of the additional hazards must also be identified, other than for radioactive materials contained in excepted packages, where the other hazardous properties take precedence.
Editor's note: source - ICAO

2.7 Class 7 Radioactive material

2.7.1 Definition of Class 7

2.7.1.1
[236]. *A substance of Class 7 is a* radioactive material as specified in 2.7.2, [107.] The Regulations do not apply to: except:

(a) radioactive material that is an integral part of the means of transport;
(b) radioactive material moved within an establishment which is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
(c)*(a)* radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
(d)*(b)* radioactive material in consumer products which have received regulatory approval, following their sale to the end user;
(e)*(c)* natural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides provided the activity concentration of the material does not exceed 10 times the values specified in 2.7.7.2 paras 401-406.

is a substance of Class 7.

Editor's Note: The Regulations do not apply to Dangerous Goods that are integral to a transport vehicle or moved within an establishment.

2.7.1.8

2.7.2 Definitions

A_1 and A_2
[201.] A_1 shall mean the activity value of special form radioactive material which is listed in Table I or derived in Section IV and is used to determine the activity limits for the requirements of these Regulations.

A_2 shall mean the activity value of radioactive material, other than special form radioactive material, which is listed in Table I or derived in Section IV and is used to determine the activity limits for the requirements of these Regulations.

[204.] *Multilateral approval* shall mean approval by the relevant competent authority both of the country of origin of the design or shipment and of each country through or into which the consignment is to be transported. The term "through or into" specifically excludes "over", i.e. the approval and notification requirements shall not apply to a country over which radioactive material is carried in an aircraft, provided that there is no scheduled stop in that country.

[205] *Unilateral approval* shall mean an approval of a design which is required to be given by the competent authority of the country of origin of the design only

[209.] *Confinement system see 6.41.*

[213.] *Containment system see 6.4.1.*

[214.] *Contamination* shall mean the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm^2 for all other alpha emitters. *This is either*:

[215.] *Non-fixed contamination* shall mean contamination that can be removed from a surface during routine conditions of transport.

[216.] *Fixed contamination* shall mean contamination other than non-fixed contamination.

[218.] *Criticality safety index (CSI) see 6.4.1.*

[221.] *Exclusive use* shall mean the sole use, by a single consignor *shipper*, of a conveyance or of a large freight container, in respect of which all initial, intermediate and final loading and unloading is carried out in accordance with the directions of the consignor *shipper* or consignee.

[222.] *Fissile material* shall mean uranium-233, uranium-235, plutonium-239, plutonium-241, or any combination of these radionuclides. Excepted from this definition is:

(a) natural uranium or depleted uranium which is unirradiated, and
(b) natural uranium or depleted uranium which has been irradiated in thermal reactors only.
See 2.7.7.1.6.

[225.] *Low dispersible radioactive material* shall mean either a solid radioactive material or a solid radioactive material in a sealed capsule, that has limited dispersibility and is not in powder form.

[226.] *Low specific activity (LSA) material* shall mean radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply (see 2.7.3).

[227]. *Low toxicity alpha emitters* are: natural uranium; depleted uranium; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical and chemical concentrates; or alpha emitters with a half-life of less than 10 days.

Package see 1.2.1.

[231M.] *Packaging see 6.4.1.*

[233.] *Radiation level* shall mean the corresponding dose rate expressed in millisieverts per hour.

[235.] *Radioactive contents* shall mean the radioactive material together with any contaminated or activated solids, liquids, and gases within the packaging.

[236] Radioactive material shall mean any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 2.7.8.

[239.] *Special form radioactive material* shall mean either an indispersible solid radioactive material or a sealed capsule containing radioactive material.

[240.] *Specific activity* of a radionuclide shall mean the activity per unit mass of that nuclide. The specific activity of a material shall mean the activity per unit mass or volume of the material in which the radionuclides are essentially uniformly distributed.

[241.] *Surface contaminated object (SCO)* shall mean a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces *(see 2.7.5)*.

[243.] *Transport index (TI) see 6.4.1.*

[244.] *Unirradiated thorium* shall mean thorium containing not more than 10^{-7} g of uranium-233 per gram of thorium-232.

[245.] *Unirradiated uranium* shall mean uranium containing not more than 2×10^{3} Bq of plutonium per gram of uranium-235, not more than 9×10^{6} Bq of fission products per gram of uranium-235 and not more than 5×10^{-3} g of uranium-236 per gram of uranium-235.

[246.] *Uranium - natural, depleted, enriched means the following:*

Natural uranium shall mean chemically separated uranium containing the naturally occurring distribution of uranium isotopes (approximately 99.28% uranium-238, and 0.72% uranium-235 by mass).

Depleted uranium shall mean uranium containing a lesser mass percentage of uranium-235 than in natural uranium.

Enriched uranium shall mean uranium containing a greater mass percentage of uranium-235 than 0.72%. In all cases, a very small mass percentage of uranium-234 is present.

2.7.3 Low Specific Activity (LSA) Material, Determination of Groups

2.7.3.1 Radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply, is termed [226.] *low specific activity or LSA material*. External shielding materials surrounding the LSA material shall not be considered in determining the estimated average specific activity.

2.7.3.2 LSA material shall be in one of three groups:

(a) LSA-I

(i) Uranium and thorium ores and concentrates of such ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;

(ii) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures;

(iii) Radioactive material for which the A_2 value is unlimited, excluding fissile material in quantities not excepted under 6.4.11.2 para. 672; or

(iv) Other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 2.7.7.2.1-2.7.7.2.6 paras 401-406, excluding fissile material in quantities not excepted under 6.4.11.2 para. 672.

(b) LSA-II

(i) Water with tritium concentration up to 0.8 TBq/L; or

(ii) Other material in which the activity is distributed throughout and the estimated average specific activity does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.

(c) LSA-III - Solids (e.g. consolidated wastes, activated materials), excluding powders, in which:

(i) The radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.);

(ii) The radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble matrix, so that, even under loss of packaging, the loss of radioactive material per package by leaching when placed in water for seven days would not exceed 0.1 A_2; and

(iii) The estimated average specific activity of the solid, excluding any shielding material, does not exceed 2×10^{-3} A_2/g.

2.7.3.3 [601.] LSA-III material shall be a solid of such a nature that if the entire contents of a package were subjected to the test specified in 2.7.3.5 para. 703 the activity in the water would not exceed 0.1 A_2.

2.7.3.4 [701.] Demonstration of compliance with the performance standards required in Section VI for LSA III material shall be accomplished by any of the methods listed below or by a combination thereof:

(a) Performance of tests with specimens representing , or special form radioactive material, or low dispersible radioactive material or with prototypes or samples of the packaging LSA-III material, where the contents of the specimen or the packaging for the tests shall simulate as closely as practicable the expected range of radioactive contents and the specimen or packaging to be tested shall be prepared as *normally* presented for transport;

(b) Reference to previous satisfactory demonstrations of a sufficiently similar nature; *or*

(c) Performance of tests with models of appropriate scale incorporating those features which are significant with respect to the item under investigation when engineering experience has shown results of such tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as penetrator diameter or compressive load, shall be taken into account.

(d) *(c)* Calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

[702.] After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment shall be used to assure that the requirements of this section have been fulfilled in compliance with the performance and acceptance standards prescribed in Section VI *2.7.3.2.*

2.7.3.5 *LSA-III material must be tested as follows:*

[703.] A solid material sample representing the entire contents of the package shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20°C. The total activity of the free volume of water shall be measured following the 7 day immersion of the test sample.

2.7.4 Requirements for Special Form Radioactive Material

2.7.4.1 [239.] *Special form radioactive material is* ~~shall mean~~ either an indispersible solid radioactive material or a sealed capsule containing radioactive material. Special form radioactive material must meet the following requirements:

(a) [604.] When if in a sealed capsule, constitutes part of the special form radioactive material, the capsule shall be so manufactured constructed that it can *only* be opened only by destroying it;

(b) [602.] Special form radioactive material *it* shall have at least one dimension not less than 5 mm; *and*

(c) the design shall have received unilateral approval.

2.7.4.2 [603.] Special form radioactive material shall be of such a nature or shall be so designed that if it is subjected to the tests specified in 2.7.4.4 to 2.7.4.8 paras ~~704-711~~, it shall meet the following requirements:

(a) It would not break or shatter under the impact, percussion and bending tests in paras ~~705, 706, 707 and 709(a)~~ as applicable;

(b) It would not melt or disperse in the *applicable* heat test in para. ~~708~~ or para. or ~~709(b)~~ as applicable; and

(c) The activity in the water from the leaching tests specified in 2.7.4.7 and 2.7.4.8 paras ~~710 and 711~~ would not exceed 2 kBq; or alternatively for sealed sources, the leakage rate for the volumetric leakage assessment test specified in the International Organization for Standardization document ISO 9978: "Radiation Protection - Sealed Radioactive Sources - Leakage Test Methods" , would not exceed the applicable acceptance threshold acceptable to the competent authority.

2.7.4.2 [701.] Demonstration of compliance with the performance standards required in Section VI shown in 2.7.4.2 shall be accomplished by any of the methods listed below or by a combination thereof.

(a) Performance of tests with specimens representing ~~LSA-III material~~, or special form radioactive material, or low dispersible radioactive material or with prototypes or samples of the packaging, where the contents of the specimen or the packaging for the tests shall simulate as closely as practicable the expected range of radioactive contents and the specimen or packaging to be tested shall be prepared as *normally* presented for transport;

(b) Reference to previous satisfactory demonstrations of a sufficiently similar nature; *or*

(c) Performance of tests with models of appropriate scale incorporating those features which are significant with respect to the item under investigation when engineering experience has shown results of such tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as penetrator diameter or compressive load, shall be taken into account.

(d)*(c)* Calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

[702.] After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment shall be used to assure that the requirements of this section have been fulfilled in compliance with the performance and acceptance standards prescribed in Section VI 2.7.4.2.

2.7.4.4 [704.] Specimens that comprise or simulate special form radioactive material shall be subjected to the impact test, the percussion test, the bending test, and the heat test specified in paras 705-709. A different specimen may be used for each of the tests. Following each test, a leaching assessment or volumetric leakage test shall be performed on the specimen by a method no less sensitive than the methods given in para. ~~710 for indispersible solid material or para. 711 for encapsulated material~~. *2.7.4.7 and 2.7.4.8.*

2.7.4.5 *The following test methods must be used:*

(a) [705.] Impact test: The specimen shall drop onto the target from a height of 9 m. The target shall be as defined in 6.4.12.2.5 ~~para. 717~~.

(b) [706]. Percussion test: The specimen shall be placed on a sheet of lead which is supported by a smooth solid surface and struck by the flat face of a mild steel bar so as to cause an impact equivalent to that resulting from a free drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of (3.0 $\pm$ 0.3) mm. The lead, of hardness number 3.5 to 4.5 on the Vickers scale and not more than 25 mm thick, shall cover an area greater than that covered by the specimen. A fresh surface of lead shall be used for each impact. The bar shall strike the specimen so as to cause maximum damage.

(c) [707.] Bending test: The test shall apply only to long, slender sources with both a minimum length of 10 cm and a length to minimum width ratio of not less than 10. The specimen shall be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp. The orientation of the specimen shall be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel bar. The bar shall strike the specimen so as to cause an impact equivalent to that resulting from a free vertical drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of (3.0 $\pm$ 0.3) mm.

(d) [708.] Heat test: The specimen shall be heated in air to a temperature of 800°C and held at that temperature for a period of 10 minutes and shall then be allowed to cool.

2.7.4.6 [709.] Specimens that comprise or simulate radioactive material enclosed in a sealed capsule may be excepted from:

(a) The tests prescribed in 2.7.4.5(a) and 2.7.4.5(b)paras 705 and 706 provided the mass of the special form radioactive material is less than 200 g and they are alternatively subjected to the Class 4 impact test prescribed in the International Organization for Standardization document ISO 2919:, "Sealed radioactive sources - Classification" , and

(b) The test prescribed in 2.7.4.5(d) para. 708 provided they are alternatively subjected to the Class 6 temperature test specified in the International Organization for Standardization document ISO 2919:, "Sealed radioactive sources - Classification" [11].

2.7.4.7 [710.] For specimens which comprise or simulate indispersible solid material, a leaching assessment shall be performed as follows:

(a) The specimen shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20°C.

(b) The water with specimen shall then be heated to a temperature of (50 ± 5)°C and maintained at this temperature for 4 hours.

(c) The activity of the water shall then be determined.

(d) The specimen shall then be kept for at least 7 days in still air at not less than 30°C and relative humidity not less than 90%.

(e) The specimen shall then be immersed in water of the same specification as in (a) above and the water with the specimen heated to (50 ± 5)°C and maintained at this temperature for 4 hours.

(f) The activity of the water shall then be determined.

2.7.4.8 [711.] For specimens which comprise or simulate radioactive material enclosed in a sealed capsule, either a leaching assessment or a volumetric leakage assessment shall be performed as follows:

(a) The leaching assessment shall consist of the following steps:

  (i) The specimen shall be immersed in water at ambient temperature. The water shall have an initial pH of 6-8 with a maximum conductivity of 1 mS/m at 20°C.

  (ii) The water and specimen shall be heated to a temperature of (50 ± 5)°C and maintained at this temperature for 4 hours.

  (iii) The activity of the water shall then be determined.

  (iv) The specimen shall then be kept for at least 7 days in still air at not less than 30°C and relative humidity of not less than 90%.

  (v) The process in (i), (ii) and (iii) shall be repeated.

(b) The alternative volumetric leakage assessment shall comprise any of the tests prescribed in the International Organization for Standardization document ISO 9978: "Radiation Protection - Sealed radioactive sources - Leakage test methods" [8], which are acceptable to the competent authority.

2.7.5 Surface Contaminated Object (SCO), Determination of Groups

[241.] *Surface contaminated object (SCO)* shall means a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces. SCO shall be *is classified* in one of two groups:

(a) SCO-I: A solid object on which:

(i) the non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 0.4 Bq/cm^2 for all other alpha emitters; and

(ii) the fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 4×10^3 Bq/cm^2 for all other alpha emitters; and

(iii) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4×10^4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 4×10^3 Bq/cm^2 for all other alpha emitters.

(b) SCO-II: A solid object on which either the fixed or non-fixed contamination on the surface exceeds the applicable limits specified for SCO-I in (a) above and on which:

(i) the non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 40 Bq/cm^2 for all other alpha emitters; and

(ii) the fixed contamination on the accessible surface, averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8×10^5 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8×10^4 Bq/cm^2 for all other alpha emitters; and

(iii) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8×10^5 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 8×10^4 Bq/cm^2 for all other alpha emitters.

2.7.6 Determination of Transport Index and Criticality Safety Index (CSI)

2.7.6.1 Determination of Transport Index

2.7.6.1.1 [526.] The transport index (TI) for a package, overpack or freight container, or for unpackaged LSA-I or SCO-I, shall be the number derived in accordance with the following procedure:

(a) Determine the maximum radiation level in units of millisieverts per hour (mSv/h) at a distance of 1 m from the external surfaces of the package, overpack, freight container, or unpackaged LSA-I and SCO-I. The value determined shall be multiplied by 100 and the resulting number is the transport index. For uranium and thorium ores and their concentrates, the maximum radiation level at any point 1 m from the external surface of the load may be taken as:

0.4 mSv/h	for ores and physical concentrates of uranium and thorium;
0.3 mSv/h	for chemical concentrates of thorium;
0.02 mSv/h	for chemical concentrates of uranium, other than uranium hexafluoride.

(b) For tanks, freight containers and unpackaged LSA-I and SCO-I, the value determined in step (a) above shall be multiplied by the appropriate factor from Table VI.

(c) The value obtained in steps (a) and (b) above shall be rounded up to the first decimal place (e.g. 1.13 becomes 1.2), except that a value of 0.05 or less may be considered as zero.

2.7.6.1.2 [527.] The transport index for each overpack, freight container or conveyance shall be determined as either the sum of the TIs of all the packages contained, or by direct measurement of radiation level, except in the case of non-rigid overpacks for which the transport index shall be determined only as the sum of the TIs of all the packages.

2.7.6.2 Determination of Criticality Safety Index (CSI)

2.7.6.2.1 [528.] The criticality safety index (CSI) for packages containing fissile material shall be obtained by dividing the number 50 by the smaller of the two values of N derived in 6.4.11.11 and 6.4.11.12 paras 681 and 682 (i.e. CSI = 50/N). The value of the criticality safety index may be zero, provided that an unlimited number of packages is subcritical (i.e. N is effectively equal to infinity in both cases).

2.7.6.2.2 [529.] The criticality safety index for each consignment shall be determined as the sum of the CSIs of all the packages contained in that consignment.

[Table VI from ST-1]

MULTIPLICATION FACTORS FOR LARGE DIMENSION LOADS

Size of load[a]	Multiplication factor
Size of load $\leq$ 1 m^2	1
1 m^2 < size of load $\leq$ 5 m^2	2
5 m^2 < size of load $\leq$ 20 m^2	3
20 m^2 < size of load	10

[a] largest cross-sectional area of the load being measured

2.7.7 Activity Limits and Material Restrictions

2.7.7.1 Contents limits for Packages

2.7.7.1.1 General

[407.] The quantity of radioactive material in a package shall not exceed the relevant limits ~~specified in paras 408-419~~ for the package type *as shown below*.

2.7.7.1.2 Excepted Packages

2.7.7.1.2.1 [408.] For radioactive material other than articles manufactured of natural uranium, depleted uranium or natural thorium, an excepted package shall not contain activities greater than the following:

(a) where the radioactive material is enclosed in or is included as a component part of an instrument or other manufactured article, such as a clock or electronic apparatus, the limits specified in columns 2 and 3 of Table III for each individual item and each package, respectively; and

(b) where the radioactive material is not so enclosed in or is not included as a component of an instrument or other manufactured article, the package limits specified in column 4 of Table III.

[Table III from ST-1]

ACTIVITY LIMITS FOR EXCEPTED PACKAGES

Physical state of contents	Instrument or article		Materials
	Item limits[a]	Package limits[a]	Package limits[a]
Solids:			
special form	$10^{-2} A_1$	A_1	$10^{-3} A_1$
other forms	$10^{-2} A_2$	A_2	$10^{-3} A_2$
Liquids:	$10^{-3} A_2$	$10^{-1} A_2$	$10^{-4} A_2$
Gases			
tritium	$2 \times 10^{-2} A_2$	$2 \times 10^{-1} A_2$	$2 \times 10^{-2} A_2$
special form	$10^{-3} A_1$	$10^{-2} A_1$	$10^{-3} A_1$
other forms	$10^{-3} A_2$	$10^{-2} A_2$	$10^{-3} A_2$

[a] For mixtures of radionuclides, see ~~paras 404-406~~ 2.7.7.2.4 to 2.7.7.2.6.

2.7.7.1.2.2 [409.] For articles manufactured of natural uranium, depleted uranium or natural thorium, an excepted package may contain any quantity of such material provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

2.7.7.1.3 Industrial packages

[411.] The radioactive contents in a single package of LSA material or in a single package of SCO shall be so restricted that the radiation level specified in 4.1.7.2.1 para. 521 shall not be exceeded, and the activity in a single package shall also be so restricted that the activity limits for a conveyance specified in 7.1.6.2 para. 525 shall not be exceeded. [412.] A single package of non-combustible solid LSA-II or LSA-III material, if carried by air, shall not contain an activity greater than 3000 A_2.

2.7.7.1.4 Type A Packages

2.7.7.1.4.1 [413.] Type A packages shall not contain activities greater than the following:

(a) for special form radioactive material - A_1; or
(b) for all other radioactive material - A_2.

Values for A_1 and A_2 are listed in Tables .

2.7.7.1.4.2 [414.] For mixtures of radionuclides whose identities and respective activities are known, the following condition shall apply to the radioactive contents of a Type A package:

$$\sum_i \frac{B(i)}{A_1(i)} + \sum_j \frac{C(j)}{A_2(j)} \leq 1$$

where

B(i) is the activity of radionuclide i as special form radioactive material and $A_1(i)$ is the A_1 value for radionuclide i; and
C(j) is the activity of radionuclide j as other than special form radioactive material and A_2 (j) is the A_2 value for radionuclide j.

2.7.7.1.5 Type B(U) and Type B(M) packages

2.7.7.1.5.1 [415.] Type B(U) and Type B(M) packages shall not contain:

(a) activities greater than those authorized for the package design,
(b) radionuclides different from those authorized for the package design, or
(c) contents in a form, or a physical or chemical state different from those authorized for the package design,

as specified in their certificates of approval.

2.7.7.1.5.2 [416.] Type B(U) and Type B(M) packages, if transported by air, shall meet the requirements of para. 415 and shall *in addition* not contain activities greater than the following:

(a) for low dispersible radioactive material - as authorized for the package design as specified in the certificate of approval,
(b) for special form radioactive material - 3000 A_1 or 100 000 A_2, whichever is the lower; or

(c) for all other radioactive material - 3000 A_2.

2.7.7.1.6 Packages containing fissile material

2.7.7.1.6.1 *Packages containing fissile material must comply with the applicable activity limits for packages specified in 2.7.8.2 to 2.7.8.4.*

2.7.7.1.6.2 [418.] Packages containing fissile material, *other than one containing materials which comply with 6.4.11.2* shall not contain:

(a) a mass of fissile material different from that authorized for the package design,
(b) any radionuclide or fissile material different from those authorized for the package design, or
(c) contents in a form or physical or chemical state, or in a spatial arrangement, different from those authorized for the package design,

as specified in their certificates of approval where appropriate.

2.7.7.1.7 Type C Packages

[417.] Type C packages shall not contain:

(a) activities greater than those authorized for the package design,
(b) radionuclides different from those authorized for the package design, or
(c) contents in a form, or physical or chemical state different from those authorized for the package design,

as specified in their certificates of approval.

2.7.7.1.8 Packages containing uranium hexaflouride

[419.] The mass of uranium hexafluoride in a package shall not exceed a value that would lead to an ullage smaller than 5% at the maximum temperature of the package as specified for the plant systems where the package shall be used. The uranium hexafluoride shall be in solid form and the internal pressure of the package shall be below atmospheric pressure when presented for transport.

2.7.7.2 Activity Levels

2.7.7.2.1 [401.] The following basic values for individual radionuclides are given in Table I:
(a) A_1 and A_2 in TBq;
(b) activity concentration for exempt material in Bq/g; and
(c) activity limits for exempt consignments in Bq.

{Insert Table I of ST-1}

2.7.7.2.2 [402.] For individual radionuclides which are not listed in Table I the determination of the basic radionuclide values referred to in 2.7.7.2.1 para. 401 shall require competent authority approval or, for international transport, multilateral approval. Where the chemical form of each radionuclide is known, it is permissible to use the A_2 value related to its solubility class as recommended by the International Commission on Radiological Protection, if the chemical forms under both normal and accident conditions of transport are taken into consideration. Alternatively, the radionuclide values in Table II may be used without obtaining competent authority approval.

[Table II from ST-1]

BASIC RADIONUCLIDE VALUES FOR UNKNOWN RADIONUCLIDES OR MIXTURES

Radioactive contents	A_1	A_2	Activity concentration for exempt material	Activity limits for exempt consignments
	(Tbq)	(Tbq)	(Bq/g)	(Bq)
Only beta or gamma nuclides are known to be present	0.1	0.02	1×10^{1}	1×10^{4}
Only alpha emitting nuclides are known to be present	0.2	9×10^{-5}	1×10^{-1}	1×10^{3}
No relevant data are available	0.001	9×10^{-5}	1×10^{-1}	1×10^{3}

2.7.7.2.3 [403.] In the calculations of A_1 and A_2 for a radionuclide not in Table I, a single radioactive decay chain in which the radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide, shall be considered as a single radionuclide; and the activity to be taken into account and the A_1 or A_2 value to be applied shall be those corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and such daughter nuclides shall be considered as mixtures of different nuclides.

2.7.7.2.4 [404.] For mixtures of radionuclides, the determination of the basic radionuclide values referred to in 2.7.7.2.1 ~~para. 401~~ may be determined as follows:

$$X_m = \frac{1}{\sum_i \frac{f(i)}{X(i)}}$$

where,

f(i) is the fraction of activity or activity concentration of radionuclide i in the mixture;
X(i) is the appropriate value of A_1 or A_2, or the activity concentration for exempt material or the activity limit for an exempt consignment as appropriate for the radionuclide i; and
X_m is the derived value of A_1 or A_2, or the activity concentration for exempt material or the activity limit for an exempt consignment in the case of a mixture.

2.7.7.2.5 [405.] When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest radionuclide value, as appropriate, for the radionuclides in each group may be used in applying the formulas in 2.7.7.2.4 and 2.7.7.1.4.2 ~~paras 404 and 414~~. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest radionuclide values for the alpha emitters or beta/gamma emitters, respectively.

2.7.7.2.6 [406.] For individual radionuclides or for mixtures of radionuclides for which relevant data are not available, the values shown in Table II shall be used.

2.7.8 Limits on Transport index (TI), Criticality Safety Index (CSI), Radiation levels for Packages and Overpacks

2.7.8.1 [530.] Except for consignments under exclusive use, the transport index of any package or overpack shall not exceed 10, nor shall the criticality safety index of any package or overpack exceed 50.

2.7.8.2 [531.] Except for packages or overpacks transported under exclusive use by rail or by road under the conditions specified in 7.2.3.1.3 subpara 572(a), or under exclusive use and special arrangement by vessel or by air under the conditions specified in 7.2.3.2.1 or 7.2.3.3.3 paras 574 or 578 respectively, the maximum radiation level at any point on any external surface of a package or overpack shall not exceed 2 mSv/h.

2.7.8.3 [532.] The maximum radiation level at any point on any external surface of a package under exclusive use shall not exceed 10 mSv/h.

2.7.8.4 [533.] Packages and overpacks shall be assigned to either category I-WHITE, II-YELLOW or III-YELLOW in accordance with the conditions specified in Table VII and with the following requirements:

(a) For a package or overpack, both the transport index and the surface radiation level conditions shall be taken into account in determining which is the appropriate category. Where the transport index satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package or overpack shall be assigned to the higher category. For this purpose, category I-WHITE shall be regarded as the lowest category.

(b) The transport index shall be determined following the procedures specified in 2.7.6.1.1 and 2.7.6.1.2. paras 526 and 527.

(c) If the surface radiation level is greater than 2 mSv/h, the package or overpack shall be transported under exclusive use and under the provisions of 7.2.3.1.3, 7.2.3.2.1, or 7.2.3.3.3 paras 572(a), 574 or 578, as appropriate.

(d) A package transported under a special arrangement shall be assigned to category III-YELLOW.

(e) An overpack which contains packages transported under special arrangement shall be assigned to category III-YELLOW.

[Table VII from ST-1]

CATEGORIES OF PACKAGES AND OVERPACKS

Conditions		
Transport index	Maximum *radiation level* at any point on external surface	*Category*
O[a]	Not more than 0.005 mSv/h	I-WHITE
More that O but not more than I[a]	More than 0.005 mSv/h but Not more than 0.5 mSv/h	II-YELLOW
More that 1 but not more than 10	More than 0.5 mSv/h but Not more than 2 mSv/h	III-YELLOW
More than 10	More than 2 mSv/h but Not more than 10 mSv/h	III-YELLOW[b]

[a] If the measured TI is not greater than 0.05, the value quoted may be zero in accordance with ~~para. 526(c)~~ 2.7.6.1.1 (c).

[b] Shall also be transported under *exclusive use*.

2.7.9 Requirements and controls for transport of excepted packages

2.7.9.1 *Radioactive material in limited quantities, instruments, manufactured articles and empty packagings as specified in 2.7.9.2 to 2.7.9.5 may be transported as excepted packages.*
[515] Excepted packages *are not subject to the provisions in 2.7.8, packing provisions in 4.1.7, labelling, marking, and other consignment requirements (Part 5), packaging nomenclature, marking, requirements and tests (Part 6), and provisions concerning transport operations (Part 7)* except ~~shall be subject only to the following provisions in Sections V and VI~~:

(a) provisions for marking in 5.2.1.5.1 to 5.2.1.5.3;
(b) the documentation provision in 5.4.1.1.7.1(c);
(c) packaging provisions as indicated in 6.4.4;
~~(a) The applicable requirements specified in 2.0.3.2, 4.1.7.2, paras 507, 508, 511, 516, 534-536, 549(c), 554 and, as applicable 517-520;~~
~~(b) The requirements for excepted packages specified in para. 620;~~

~~(c)~~ (d) If the excepted package contains fissile material, one of the fissile exceptions provided by 6.4.11.2 ~~para. 672~~ shall apply and the requirement of 6.4.7.2 ~~para. 634~~ shall be met; ~~and~~
~~(d) The requirements in paras 579 and 580 if transported by post.~~
(e) provisions pertaining to damaged, leaking or contaminated packages in 7.1.6.5; and
(f) provisions specifically mentioned in the Section.

2.7.9.2 [516.] The radiation level at any point on the external surface of an excepted package shall not exceed 5 μSv/h.

2.7.9.3 [517.] Radioactive material which is enclosed in or is included as a component part of an instrument or other manufactured article, with activity not exceeding the item and package limits specified in columns 2 and 3 respectively of Table III, may be transported in an excepted package provided that:

(a) The radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article is not greater than 0.1 mSv/h; and

(b) Each instrument or article (except radioluminescent time-pieces or devices) bears the marking "RADIOACTIVE"; and

(c) The active material is completely enclosed by non-active components (a device performing the sole function of containing radioactive material shall not be considered to be an instrument or manufactured article).

2.7.9.4 [518.] Radioactive material in forms other than as specified in 2.7.9.3para. 517, with an activity not exceeding the limit specified in column 4 of Table III, may be transported in an excepted package provided that:

(a) the package retains its radioactive contents under routine conditions of transport; and

(b) the package bears the marking "RADIOACTIVE" on an internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package.

2.7.9.5 [519.] A manufactured article in which the sole radioactive material is unirradiated natural uranium, unirradiated depleted uranium or unirradiated natural thorium may be transported as an excepted package provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

2.7.9.6 [520.] An empty packaging which had previously contained radioactive material may be transported as an excepted package provided that:

(a) It is in a well maintained condition and securely closed;

(b) The outer surface of any uranium or thorium in its structure is covered with an inactive sheath made of metal or some other substantial material;

(c) The level of internal non-fixed contamination does not exceed one hundred times the levels specified in 4.1.7.1.2 para. 508; and

(d) Any labels which may have been displayed on it in conformity with 5.2.2.1.11.1 para. 541, are no longer visible.

2.7.10 Low dispersible radioactive material

2.7.10.1 Requirements for low dispersible radioactive material

[605.] Low dispersible radioactive material shall be such that the total amount of this radioactive material in a package shall meet the following requirements:

(a) The radiation level at 3 m from the unshielded radioactive material does not exceed 10 mSv/h;

(b) If subjected to the tests specified in 6.4.12.2.24 and 6.4.12.2.25 paras 736 and 737, the airborne release in gaseous and particulate forms of up to 100 μm aerodynamic equivalent diameter would not exceed 100 A_2. A separate specimen may be used for each test; and

(c) If subjected to the test specified in 2.7.3.5 para. 703 the activity in the water would not exceed 100 A_2. In the application of this test, the damaging effects of the tests specified in (b) above shall be taken into account.

2.7.10.2 Tests for low dispersible radioactive material

[712.] A specimen that comprises or simulates low dispersible radioactive material shall be subjected to the enhanced thermal test specified in 6.4.12.2.24 para. 736 and the impact test specified in 6.4.12.2.24 para. 737. A different specimen may be used for each of the tests. Following each test, the specimen shall be subjected to the leach test specified in 2.7.3.5 para. 703. After each test it shall be determined if the applicable requirements of 2.7.10.1 para. 605 have been met.

PART 3
Dangerous goods lists and limited quantities exceptions

PART 3. DANGEROUS GOODS LIST AND LIMITED QUANTITIES EXCEPTIONS

Chapter 3.1 -General

3.1.1 Scope and general provisions
3.1.2 Proper shipping name
3.1.3 Mixtures and solutions containing one dangerous substance

Chapter 3.2 -Dangerous goods list

3.2.1 Structure of the dangerous goods list
3.2.2 Abbreviations and symbols

Chapter 3.3 -Special provisions

3.3.1 Special provisions applicable to certain articles or substances
3.3.2 Special provisions applicable to transport in packagings or IBCs
3.3.3 Special provisions applicable to transport in portable tanks

Chapter 3.4 -Dangerous goods packed in limited quantities

In the dangerous goods list, modify the table to incorporate the revisions to the entries below:

2908	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - EMPTY PACKAGING	7			172	NONE	See Chapter 2.7
2909	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - ARTICLES MANUFACTURED FROM NATURAL URANIUM or DEPLETED URANIUM or NATURAL THORIUM	7			172	NONE	See Chapter 2.7
2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - LIMITED QUANTITY OF MATERIAL	7			172	NONE	See Chapter 2.7
2911	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - INSTRUMENTS or ARTICLES	7			172	NONE	See Chapter 2.7
2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I), non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7 T6 TP4
2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7
2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE, non-special form, non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7
2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7
2917	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7
2919	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7

2977	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, FISSILE	7	8		174	NONE	See Chapter 2.7 and Section 4.1.7
2978	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, non fissile or fissile-excepted	7	8		174	NONE	See Chapter 2.7 and Section 4.1.7

3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7 T6 TP4
3322	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7 T6 TP4
3323	RADIOACTIVE MATERIAL, TYPE C PACKAGE, non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3324	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3325	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY, (LSA-III), FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3326	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3327	RADIOACTIVE MATERIAL, TYPE A PACKAGE, FISSILE, non-special form	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3328	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3329	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3330	RADIOACTIVE MATERIAL, TYPE C PACKAGE, FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3331	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, FISSILE	7			172	NONE	See Chapter 2.7 and Section 4.1.7
3332	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, non fissile or fissile-excepted	7			172	NONE	See Chapter 2.7 and Section 4.1.7

PART 4
Packing and tank provisions

Part 4. PACKING AND TANK PROVISIONS

Chapter 4.1 -Use of packagings and intermediate bulk containers (IBCs)

4.1.1 General provisions for the packing of dangerous goods, other than goods of Classes 2 or 7 or Division 6.2.
4.1.2 General provisions for the use of IBCs
4.1.3 Special packaging provisions for goods of Class 1
4.1.4 Special packaging provisions for Class 2
4.1.5 Special packaging provisions for organic peroxides (Division 5.2) and self-reactive substances of Division 4.1
4.1.6 General provisions for the packing of Division 6.2 substances
4.1.7 Special packaging provisions for Class 7
4.1.8 Special packaging provisions for dangerous goods other than self-reactive substances of Division 4.1 or than goods of Class 1, 2, 7 or Division 5.2 or 6.2

Chapter 4.2-Use of portable tanks

4.2.1 General provisions for the use of portable tanks for the transport of substances in Classes 3 to 9
4.2.2 General provisions for the use of portable tanks for the transport of non-refrigerated, pressure liquefiable gases
4.2.3 General provisions for the use of portable tanks for the transport of refrigerated, liquefied gases
4.2.4 Portable tank instructions

4.1.7 Special packaging provisions for Class 7

4.1.7.1 General

4.1.7.1.1 Radioactive material, packagings and packages shall meet the requirements of Chapter 6.4. The quantity of radioactive material in a package shall not exceed the limits specified in 2.7.7.1.

4.1.7.1.2 [508.] The non-fixed contamination on the external surfaces of any package shall be kept as low as practicable and, under routine conditions of transport, shall not exceed the following limits:

(a) 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, and
(b) 0.4 Bq/cm^2 for all other alpha emitters.

These limits are applicable when averaged over any area of 300 cm^2 of any part of the surface.

4.1.7.1.3 [503.] A package shall not contain any other items except such articles and documents as are necessary for the use of the radioactive material. This requirement shall not preclude the transport of low specific activity material or surface contaminated objects with other items. The transport of such articles and documents in a package, or of low specific activity material or surface contaminated objects with other items may be permitted provided that there is no interaction between them and the packaging or its radioactive contents that would reduce the safety of the package.

4.1.7.1.4 [509.] Except as provided in 7.1.6.5.5 para. 514, the level of non-fixed contamination on the external and internal surfaces of overpacks, freight containers, tanks and intermediate bulk containers shall not exceed the limits specified in 4.1.7.1.2 para. 508.

4.1.7.1.5 *[109M] Radioactive material meeting the criteria of other Classes or Divisions as defined in Part 2 shall be allocated to Packing Group I, II, or III, as appropriate, by the application of the grouping criteria provided in Part 2 corresponding to the nature of the predominant subsidiary risk. Unless contained in a Type A, B or C package, it must also meet the appropriate packaging requirements for the subsidiary risk.*

4.1.7.2 Requirements and controls for transport of LSA material and SCO

4.1.7.2.1 [521.] The quantity of LSA material or SCO in a single Industrial package Type 1 (Type IP-1), Industrial package Type 2 (Type IP-2), Industrial package Type 3 (Type IP-3), or object or collection of objects, whichever is appropriate, shall be so restricted that the external radiation level at 3 m from the unshielded material or object or collection of objects does not exceed 10 mSv/h.

4.1.7.2.2 [522.] LSA material and SCO which is or contains fissile material shall meet the applicable requirements of 7.1.6.4.1, 7.1.6.4.2, and 6.4.11.1 paras 568, 569 and 671.

4.1.7.2.3 [523.] LSA material and SCO in groups LSA-I and SCO-I may be transported unpackaged under the following conditions:

(a) All unpackaged material other than ores containing only naturally occurring radionuclides shall be transported in such a manner that under routine conditions of transport there will be no escape of the radioactive contents from the conveyance nor will there be any loss of shielding;

(b) Each conveyance shall be under exclusive use, except when only transporting SCO-I on which the contamination on the accessible and the inaccessible surfaces is not greater than ten times the applicable level specified in 2.7.2 para. ~~214~~; and

(c) For SCO-I where it is suspected that non-fixed contamination exists on inaccessible surfaces in excess of the values specified in 2.7.5 para. ~~241(a)(i)~~, measures shall be taken to ensure that the radioactive material is not released into the conveyance.

4.1.7.2.4 [524.] LSA material and SCO, except as otherwise specified in 4.1.7.2.3 para. 523, shall be packaged in accordance with Table IV.

[Table IV from ST-1]

INDUSTRIAL PACKAGE REQUIREMENTS FOR LSA MATERIAL AND SCO

Radioactive contents	*Industrial package type*	
	Exclusive use	*Not under exclusive use*
LSA-I		
Solid[a]	*Type IP-1*	*Type IP-1*
Liquid	*Type IP-1*	*Type IP-2*
LSA-II		
Solid	*Type IP-2*	*Type IP-2*
Liquid and gas	*Type IP-2*	*Type IP-3*
LSA-III	*Type IP-2*	*Type IP-3*
SCO-I[a]	*Type IP-1*	*ype IP-1*
SCO-II	*Type IP-2*	*Type IP-2*

[a] Under the conditions specified in para. 523, LSA-I material and SCO-I may be transported unpackaged.

PART 5

Consignment procedures

PART 5 Consignment procedures

5.1 General Provisions

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Number the existing paragraph under 5.1.3 (Empty Packagings) as 5.1.3.1 and add the following additional paragraph:

5.1.3.2 [504.] Tanks and intermediate bulk containers used for the transport of radioactive material shall not be used for the storage or transport of other goods unless decontaminated below the level of 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters and 0.04 Bq/cm^2 for all other alpha emitters.

5.1.5 General Provisions for Class 7

5.1.5.1 Requirements before shipments

5.1.5.1.1 First Shipment of a package

[501.] Before the first shipment of any package, the following requirements shall be fulfilled:

(a) If the design pressure of the containment system exceeds 35 kPa (gauge), it shall be ensured that the containment system of each package conforms to the approved design requirements relating to the capability of that system to maintain its integrity under that pressure.

(b) For each Type B(U), Type B(M) and Type C package and for each package containing fissile material, it shall be ensured that the effectiveness of its shielding and containment and, where necessary, the heat transfer characteristics and the effectiveness of the confinement system, are within the limits applicable to or specified for the approved design.

(c) For packages containing fissile material, where, in order to comply with the requirements of 6.4.11.1 para. 671, neutron poisons are specifically included as components of the package, checks shall be performed to confirm the presence and distribution of those neutron poisons.

5.1.5.1.2 All shipments

[502.] Before each shipment of any package, the following requirements shall be fulfilled:

(a) For any package it shall be ensured that all the requirements specified in the relevant provisions of these Regulations have been satisfied.

(b) It shall be ensured that lifting attachments which do not meet the requirements of 6.4.2.2 para. 607 have been removed or otherwise rendered incapable of being used for lifting the package, in accordance with 6.4.2.3 para. 608.

(c) For each Type B(U), Type B(M) and Type C package and for each package containing fissile material, it shall be ensured that all the requirements specified in the approval certificates have been satisfied.

(d) Each Type B(U), Type B(M) and Type C package shall be held until equilibrium conditions have been approached closely enough to demonstrate compliance with the requirements for temperature and pressure unless an exemption from these requirements has received unilateral approval.

(e) For each Type B(U), Type B(M) and Type C package, it shall be ensured by inspection and/or appropriate tests that all closures, valves, and other openings of the containment system through which the radioactive contents might escape are properly closed and, where appropriate, sealed in the manner for which the demonstrations of compliance with the requirements of 6.4.8.7 and 6.4.10.3 paras 656 and 669 were made.

(f) For each special form radioactive material, it shall be ensured that all the requirements specified in the special form approval certificate and the relevant provisions of these Regulations have been satisfied.

(g) For packages containing fissile material the measurement specified in 6.4.11.4(b) para. 674(b) and the tests to demonstrate closure of each package as specified in 6.4.11.7 para. 677 shall be performed where applicable.

(h) For each low dispersible radioactive material, it shall be ensured that all the requirements specified in the approval certificate and the relevant provisions of these Regulations have been satisfied.

5.1.5.2 Approval of shipments and notification

5.1.5.2.1 General

In addition to the approval for packaging designs described in Chapter 6.4 , multilateral shipment approval is also required in certain circumstances. In some circumstances it is also necessary to notify competent authorities of a shipment.
[Editor's Note: ICAO text.]

5.1.5.2.2 Shipment Approvals

[820.] Multilateral approval shall be required for:

(a) the shipment of Type B(M) packages not conforming with the requirements of 6.4.7.5 para. 637 or designed to allow controlled intermittent venting;

(b) the shipment of Type B(M) packages containing radioactive material with an activity greater than 3000 A_1 or 3000 A_2, as appropriate, or 1000 TBq, whichever is the lower;

(c) the shipment of packages containing fissile materials if the sum of the criticality safety indexes of the packages exceeds 50; and

(d) radiation protection programmes for shipments by special use vessels according to 7.2.3.2.2 para. 575 (a);

except that a [821.] A competent authority may authorize transport into or through its country without shipment approval, by a specific provision in its design approval (see para. 827).

5.1.5.2.3 Shipment Approval by Special Arrangement

Provisions may be approved by a competent authority under which a consignment, which does not satisfy all of the applicable requirements of these Regulations may be transported under special arrangement (see 1.1.2.3).

5.1.5.3.2.4 Notifications

Notification to competent authorities is required as follows:

(a) [557.] Before the first shipment of any package requiring competent authority approval, the consignor *shipper* shall ensure that copies of each applicable competent authority certificate applying to that package design have been submitted to the competent authority of each country through or into which the consignment is to be transported. The consignor *shipper* is not required to await an acknowledgement from the competent authority, nor is the competent authority required to make such acknowledgement of receipt of the certificate.

(b) [558M] For each of the following types of shipments:

(1) Type C packages containing radioactive material with an activity greater than 3000 A_1 or 3000 A_2, as appropriate, or 1000 TBq, whichever is the lower;
(2) Type B(U) packages containing radioactive material with an activity greater than 3000 A_1 or 3000 A_2, as appropriate, or 1000 TBq, whichever is the lower;
(3) Type B(M) packages;
(4) Shipment under special arrangement,

the consignor *shipper* shall notify the competent authority of each country through or into which the consignment is to be transported. This notification shall be in the hands of each competent authority prior to the commencement of the shipment, and preferably at least 7 days in advance.

(c) [560.] The consignor *shipper* is not required to send a separate notification if the required information has been included in the application for shipment approval. See para. 822.

(d) [559.] The consignment notification shall include:

(1) Sufficient information to enable the identification of the package or packages including all applicable certificate numbers and identification marks;
(2) Information on the date of shipment, the expected date of arrival and proposed routeing;
(3) The names of the radioactive materials or nuclides;
(4) Descriptions of the physical and chemical forms of the radioactive material, or whether it is special form radioactive material or low dispersible radioactive material; and
(5) The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with an appropriate SI prefix (see Annex II). For fissile material, the mass of fissile material in units of grams (g), or multiples thereof, may be used in place of activity.

5.1.5.4 Certificates issued by Competent Authority

5.1.5.4.1 [561M]The consignor *shipper* must have in his possession a copy of each applicable certificate shown below. He must also have a copy of any instructions with regard to the proper closing of the package and any preparation for shipment before making any shipment under the terms of the certificates *for*:

[802.] Competent authority approval shall be required for the following:

(a) designs for
  (i) special form radioactive material (see 6.4.14.4 paras 803, 804 and 818);
  (ii) low dispersible radioactive material (see paras 803 and 804);
  (iii) packages containing 0.1 kg or more of uranium hexafluoride (see 6.4.13.1 para. 805);
  (iv) all packages containing fissile material unless excepted by 6.4.11.2 para. 672 (see 6.4.13.4 paras 812-814, 6.4.14.2 816 and 6.4.14.3 817);
  (v) Type B(U) packages and Type B(M) packages (see 6.4.13.2 to 6.4.13.4 paras 806-811, 6.4.14.2 816 and 6.4.14.3 817);
  (vi) Type C packages (see paras 6.4.13.2 806-808);
(b) special arrangements (see paras 824-826);
(c) certain shipments (see 5.1.5.2.2 paras 820-823);
(d) radiation protection programme for special use vessels (see 7.2.3.2.2(a)para. 575(a)); and
(e) calculation of radionuclide values that are not listed in Table I (see 2.7.7.2.2para. 402).

The package design and shipment approval certificates may be combined into a single certificate.

5.1.5.4.2 [801.] For package designs where it is not required that a competent authority issue an approval certificate the consignor *shipper* shall, on request, make available for inspection by the relevant competent authority, documentary evidence of the compliance of the package design with all the applicable requirements.

5.2 Marking and Labelling of Packages

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5.2.1 Marking

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5.2.1.5 Special Marking Provisions for Class 7

5.2.1.5.1 [534.] Each package shall be legibly and durably marked on the outside of the packaging with an identification of either the consignor *shipper* or consignee, or both.

5.2.1.5.2 [535M.] For each package, other than excepted packages, the United Nations number preceded by the letters "UN", and the proper shipping name shall be legibly and durably marked on the outside of the packaging. In the case of excepted packages, other than those accepted for international movement by post, only the United Nations number, preceded by the letters "UN", shall be required. For packages accepted for international movement by post the requirement of para. 580 shall apply.

5.2.1.5.3 [536.] Each package of gross mass exceeding 50 kg shall have its permissible gross mass legibly and durably marked on the outside of the packaging.

5.2.1.5.4 [537.] Each package which conforms to:

(a) an Industrial package Type 1, an Industrial package Type 2 or an Industrial package Type 3 design shall be legibly and durably marked on the outside of the packaging with "TYPE IP-1", "TYPE IP-2" or "TYPE IP-3" as appropriate;

(b) a Type A package design shall be legibly and durably marked on the outside of the packaging with "TYPE A";

(c) an Industrial package Type 2, an Industrial package Type 3 or a Type A package design shall be legibly and durably marked on the outside of the packaging with the international vehicle registration code (VRI Code) of the country of origin of design and the name of the manufacturers, or other identification of the packaging specified by the competent authority.

5.2.1.5.5 [538.] Each package which conforms to a design approved under 6.4.13.1 to 6.4.13.4 paras 805-814 or 6.4.14.2 and 6.4.14.3 816-817 shall be legibly and durably marked on the outside of the packaging with:

(a) The identification mark allocated to that design by the competent authority;

(b) A serial number to uniquely identify each packaging which conforms to that design;

(c) In the case of a Type B(U) or Type B(M) package design, with "TYPE B(U)" or "TYPE B(M)"; and

(d) In the case of a Type C package design, with "TYPE C".

5.2.1.5.6 [539.] Each package which conforms to a Type B(U), Type B(M) or Type C package design shall have the outside of the outermost receptacle which is resistant to the effects of fire and water plainly marked by embossing, stamping or other means resistant to the effects of fire and water with the trefoil symbol shown in Fig. 1.

{Location to be found for Fig.1 from ST-1}

5.2.1.5.7 [540.] Where LSA-I or SCO-I material is contained in receptacles or wrapping materials and is transported under exclusive use as permitted by 4.1.7.2.3 para. 523, the outer surface of these receptacles or wrapping materials may bear the marking 'RADIOACTIVE LSA-I' or 'RADIOACTIVE SCO-I', as appropriate.

5.2.2 Labelling

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5.2.2.1.11 Special Provisions for the labelling of radioactive materials

5.2.2.1.11.1 *[541 and 542M] Except as provided for large freight containers and tanks in accordance with [546], each package, overpack and freight container containing radioactive material shall bear at least two labels which conform to the models Nos.7A, 7B, and 7C as appropriate according to the category (see 2.7.8.4) of that package, overpack or freight container. Labels must be affixed to two opposite sides on the outside of the package or on the outside of all four sides of the freight container. Each rigid overpack containing radioactive material must bear at least two labels on opposite sides of the outside of the overpack, while each non-rigid overpack must bear at least one label affixed by a securely attached durable tag. In addition, each package, overpack and freight container containing fissile material, other than an excepted package must bear labels which conform to model No.7D; such labels, where applicable must be affixed adjacent to the labels for radioactive material. Labels shall not cover the markings specified in 5.2. Any labels which do not relate to the contents shall be removed or covered.*

5.2.2.1.11.2 [543.] Each label conforming to the models *numbers 7A, 7B, and 7C* in Fig. 2, Fig. 3 and Fig. 4 shall be completed with the following information:

(a) Contents:
  (i) Except for LSA-I material, the name(s) of the radionuclide(s) as taken from Table I, using the symbols prescribed therein. For mixtures of radionuclides, the most restrictive nuclides must be listed to the extent the space on the line permits. The group of LSA or SCO shall be shown following the name(s) of the radionuclide(s). The terms "LSA-II","LSA-III", "SCO-I" and "SCO-II" shall be used for this purpose.
  (ii) For LSA-I material, the term "LSA-I" is all that is necessary; the name of the radionuclide is not necessary.

(b) Activity: The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with the appropriate SI prefix (see Annex II). For fissile material, the mass of fissile material in units of grams (g), or multiples thereof, may be used in place of activity.

(c) For overpacks and freight containers the "contents" and "activity" entries on the label shall bear the information required in 5.2.2.1.11.2(a) and 5.2.2.1.11.2(b) subparas 543(a) and 543(b), respectively, totalled together for the entire contents of the overpack or freight container except that on labels for overpacks or freight containers containing mixed loads of packages containing different radionuclides, such entries may read "See Transport Documents".

(d) Transport index: See 2.7.6.1.1 and 2.7.6.1.2 paras 526 and 527. (No transport index entry is required for category I-WHITE.)

5.2.2.1.11.3 [544.] Each label conforming to the model in Fig. 5 *number 7D* shall be completed with the criticality safety index (CSI) as stated in the certificate of approval for special arrangement or the certificate of approval for the package design issued by the competent authority.

5.2.2.1.11.4 [545.] For overpacks and freight containers, the criticality safety index (CSI) on the label shall bear the information required in 5.2.2.1.11.3 para. 544 totalled together for the fissile contents of the overpack or freight container.

5.3.1.3 Placards for Class 7

5.3.1.3.1 [546.] Large freight containers carrying packages other than excepted packages, and tanks shall bear four placards which conform with the model given in *Figure 5.1.* The placards shall be affixed in a vertical orientation to each side wall and each end wall of the large freight container or tank. Any placards which do not relate to the contents shall be removed. Instead of using both labels and placards, it is permitted as an alternative to use enlarged labels only, as shown in label model Nos. 7A, B and C, and where appropriate 7 D, with dimensions as required for the placard in *Figure 5.1.*

5.3.1.3.2 [547M.] Where the consignment in the freight container or tank is unpackaged LSA-I or SCO-I or where an exclusive use consignment in a freight container is packaged radioactive material with a single United Nations number, the appropriate United Nations number for the consignment shall also be displayed, in black digits not less than 65 mm high, either:

(a) in the lower half of the placard model in *figure 5.1*, preceded by the letters "UN" and against the white background, or

(b) on a orange rectangular panel as shown in Figure 5.3.

When the alternative given in (b) above is used, the subsidiary placard shall be affixed immediately adjacent to the primary hazard placard, on all four sides of the freight container or tank.

Chapter 5.4 Documentation

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5.4.1.1.7 Provisions for Radioactive Material : Particulars of consignment

5.4.1.1.7.1 [549M.] The consignor *shipper* shall include in the transport documents with each consignment the following information, as applicable in the order given:

(a) The proper shipping name;
(b) The United Nations Class number "7";
(c) The United Nations number assigned to the material preceded by the letters "UN";
(d) The name or symbol of each radionuclide or, for mixtures of radionuclides, an appropriate general description or a list of the most restrictive nuclides;
(e) A description of the physical and chemical form of the material, or a notation that the material is special form radioactive material or low dispersible radioactive material. A generic chemical description is acceptable for chemical form;
(f) The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with an appropriate SI prefix (see Annex II). For fissile material, the mass of fissile material in units of grams (g), or appropriate multiples thereof, may be used in place of activity.
(g) The category of the package, i.e. I-WHITE, II-YELLOW, III-YELLOW;
(h) The transport index (categories II-YELLOW and III-YELLOW only);
(i) For consignments including fissile material other than consignments excepted under para. 672, the criticality safety index;
(j) The identification mark for each competent authority approval certificate (special form radioactive material, low dispersible radioactive material, special arrangement, package design, or shipment) applicable to the consignment;
(k) For consignments of packages in an overpack or freight container, a detailed statement of the contents of each package within the overpack or freight container and, where appropriate, of each overpack or freight container in the consignment. If packages are to be removed from the overpack or freight container at a point of intermediate unloading, appropriate transport documents shall be made available;
(l) Where a consignment is required to be shipped under exclusive use, the statement "EXCLUSIVE USE SHIPMENT"; and
(m) For LSA-II, LSA-III, SCO-I and SCO-II, the total activity of the consignment as a multiple of A_2.

5.4.1.1.7.2 [555.] The consignor *shipper* shall provide in the transport documents a statement regarding actions, if any, that are required to be taken by the carrier. The statement shall be in the languages deemed necessary by the carrier or the authorities concerned, and shall include at least the following points:

(a) Supplementary requirements for loading, stowage, carriage, handling and unloading of the package, overpack or freight container including any special stowage provisions for the safe dissipation of heat (see 7.1.6.3.2 para. 565), or a statement that no such requirements are necessary;
(b) Restrictions on the mode of transport or conveyance and any necessary routing instructions;
(c) Emergency arrangements appropriate to the consignment.

5.4.1.1.7.3 [556.] The applicable competent authority certificates need not necessarily accompany the consignment. The consignor *shipper* shall make them available to the carrier(s) before loading and unloading.

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In the existing 5.4.1.1.11, delete the parenthetical reference to ST-1 and add the following to the end of the paragraph after the declaration:

[552.] The declaration shall be signed and dated by the consignor *shipper*. Facsimile signatures are acceptable where applicable laws and regulations recognize the legal validity of facsimile signatures.]

PART 6

Requirements for the construction and testing of Packagings, Intermediate Bulk Containers (IBCs), and PortableTanks

PART 6 Requirements for the construction and testing of Packagings, Intermediate Bulk Containers (IBCs), and Portable Tanks

Chapter 6.4 Requirements for the Construction, Testing and Approval of Packages and Materials of Class 7

6.4.1 General Nomenclature for Class 7

When the following terms are used in these Regulations in relation to the packing of radioactive material, they have the meaning indicated:

[209.] *Confinement system* shall mean the assembly of fissile material and packaging components specified by the designer and agreed to by the competent authority as intended to preserve criticality safety.

[213.] *Containment system* shall mean the assembly of components of the packaging specified by the designer as intended to retain the radioactive material during transport.

[218.] *Criticality safety index (CSI)* assigned to a package, overpack or freight container containing fissile material shall mean a number which is used to provide control over the accumulation of packages, overpacks or freight containers containing fissile material.

[220.] *Design* shall mean the description of special form radioactive material, low dispersible radioactive material, package or packaging which enables such an item to be fully identified. The description may include specifications, engineering drawings, reports demonstrating compliance with regulatory requirements, and other relevant documentation.

Freight container see 1.2.1.

[228.] *Maximum normal operating pressure* shall mean the maximum pressure above atmospheric pressure at mean sea-level that would develop in the containment system in a period of one year under the conditions of temperature and solar radiation corresponding to environmental conditions in the absence of venting, external cooling by an ancillary system, or operational controls during transport.

Package see 1.2.1.

[231M.] *Packaging* shall mean the assembly of components necessary to enclose the radioactive contents completely. It may, in particular, consist of one or more receptacles, absorbent materials, spacing structures, radiation shielding and service equipment for filling, emptying, venting and pressure relief; devices for cooling, absorbing mechanical shocks, handling and tie-down, thermal insulation; and service devices integral to the package. The packaging may be a box, drum or similar receptacle, or may also be a freight container, tank or intermediate bulk container.

Tank see 1.2.1.

[243.] *Transport index (TI)* assigned to a package, overpack or freight container, or to unpackaged LSA-I or SCO-I, shall mean a number which is used to provide control over radiation exposure.

6.4.2 General requirements

6.4.2.1 [606].] The package shall be so designed in relation to its mass, volume and shape that it can be easily and safely transported. In addition, the package shall be so designed that it can be properly secured in or on the conveyance during transport.

6.4.2.2 [607.] The design shall be such that any lifting attachments on the package will not fail when used in the intended manner and that, if failure of the attachments should occur, the ability of the package to meet other requirements of these Regulations would not be impaired. The design shall take account of appropriate safety factors to cover snatch lifting.

6.4.2.3 [608.] Attachments and any other features on the outer surface of the package which could be used to lift it shall be designed either to support its mass in accordance with the requirements of 6.4.2.2 para. 607 or shall be removable or otherwise rendered incapable of being used during transport.

6.4.2.4 [609.] As far as practicable, the packaging shall be so designed and finished that the external surfaces are free from protruding features and can be easily decontaminated.

6.4.2.5 [610.] As far as practicable, the outer layer of the package shall be so designed as to prevent the collection and the retention of water.

6.4.2.6 [612.]The package shall be capable of withstanding the effects of any acceleration, vibration or vibration resonance which may arise under routine conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole. In particular, nuts, bolts and other securing devices shall be so designed as to prevent them from becoming loose or being released unintentionally, even after repeated use.

6.4.2.7 [613.] The materials of the packaging and any components or structures shall be physically and chemically compatible with each other and with the radioactive contents. Account shall be taken of their behaviour under irradiation.

6.4.2.8 [614.] All valves through which the radioactive contents could otherwise escape shall be protected against unauthorized operation.

6.4.2.9 [615.] The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.

6.4.2.10 [616.] For radioactive material having other dangerous properties the package design shall take into account those properties; see 4.1.7.1.5 paras 109 and 2.0.3.2 507.

6.4.3 Additional requirements for packages transported by air

6.4.3.1 [617.] For packages to be transported by air, the temperature of the accessible surfaces shall not exceed 50°C at an ambient temperature of 38°C with no account taken for insolation.

6.4.3.2 [618.] Packages to be transported by air shall be so designed that, if they were exposed to ambient temperatures ranging from -40°C to +55°C, the integrity of containment would not be impaired.

6.4.3.3 [619.] Packages containing radioactive material transported by air shall have a containment system able to withstand without leakage a reduction in ambient pressure to 5 kPa.

6.4.4 Requirements for excepted packages

[620.] An excepted package shall be designed to meet the requirements specified in 6.4.2.1 to 6.4.2.10 paras 606-616 and in addition, the requirements of 6.4.3 paras 617-619 if carried by air.

Requirements for Packages

6.4.5 Requirements for Industrial packages
Industrial package Type 1 (Type IP-1)
Industrial package Type 2 (Type IP-2)
Industrial package Type 3 (Type IP-3)

6.4.5.1 [621.M] Industrial packages Types 1 ,2, and 3 shall meet the general requirements of this Chapter including, if appropriate, the additional requirements for air transport.

6.4.5.2 [622M.] An Industrial Package Type 2 shall, if it were subjected to the tests specified in paras 6.4.12.2.10 and 6.4.12.2.11 722 and 723, prevent:

(a) loss or dispersal of the radioactive contents; and

(b) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

6.4.5.3 [623M.] A Type 3 shall meet all the requirements specified in 6.4.7.2 to 6.4.7.15 paras 634-647.

6.4.5.4 Alternative requirements for Industrial package Type 2 or Industrial package Type 3

6.4.5.4.1 [624M.] Packages may be used as Industrial package Type 2 provided that:

(a) They satisfy the requirements of 6.4.5.1;
(b) They are designed to conform to the standards prescribed in the Chapter 6.1; and
(c) When subjected to the tests required for Packing Group II in Chapter 6.1, they would prevent:
  (i) loss or dispersal of the radioactive contents; and
  (ii) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

6.4.5.4.2 [625M.] *Portable tanks* Tank containers may also be used as Industrial package Types 2 or 3, provided that:

(a) They satisfy the requirements of 6.4.5.1;
(b) They are designed to conform to the standards prescribed in the chapter *6.6 of the Regulations*, and are capable of withstanding a test pressure of 265 kPa; and
(c) They are designed so that any additional shielding which is provided shall be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of transport and of preventing a loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external *tank* surface of the tank containers.

6.4.5.4.3 [626.] Tanks, other than tank containers *portable tanks*, may also be used as Industrial package Types 2 or 3 (Type IP-2) or (Type IP-3) for transporting LSA-I and LSA-II liquids and gases as prescribed in Table IV, provided that they conform to standards at least equivalent to those prescribed in 6.4.5.4.2 para 625.

6.4.5.4.4 [627.] Freight containers may also be used as Industrial package Types 2 or 3, (Type IP-2) or (Type IP-3), provided that:

(a) The radioactive contents are restricted to solid materials;
(b) They satisfy the requirements for Type IP-1 specified in para. 621 *of 6.4.5.1*; and

(c) They are designed to conform to the standards prescribed in the International Organization for Standardization document ISO 1496/1:, "Series 1 Freight Containers - Specifications and Testing - Part 1: General Cargo Containers" excluding dimensions and ratings. They shall be designed such that if subjected to the tests prescribed in that document and the accelerations occurring during routine conditions of transport they would prevent:
(i) loss or dispersal of the radioactive contents; and
(ii) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the freight containers.

6.4.5.4.5 [628M.] Metal intermediate bulk containers may also be used as Industrial package Type 2 or 3 provided that:

(a) They satisfy the requirements *of 6.4.5.1*; and
(b) They are designed to conform to the standards and tests prescribed in the chapter 6.5 of the Regulations for Packing Group II, and when subjected to drop test on the most vulnerable part, they would prevent:
(i) loss or dispersal of the radioactive contents; and
(ii) loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the intermediate bulk container.

6.4.6 Requirements for packages containing uranium hexafluoride

6.4.6.1 [629.] Except as allowed in 6.4.6.4 para. 632, uranium hexafluoride shall be packaged and transported in accordance with the provisions of the International Organization for Standardization document ISO 7195:, "Packaging of uranium hexafluoride (UF_6) for transport", and the requirements of 6.4.6.2 and 6.4.6.3 paras 630-631. The package shall also meet the requirements prescribed elsewhere in these Regulations which pertain to the radioactive and fissile properties of the material.

6.4.6.2 [630.] Each package designed to contain 0.1 kg or more of uranium hexafluoride shall be designed so that it would meet the following requirements:

(a) withstand without leakage and without unacceptable stress, as specified in the International Organization for Standardization document ISO 7195 [10], the structural test as specified in 6.4.12.2.6 para. 718;
(b) withstand without loss or dispersal of the uranium hexafluoride the test specified in 6.4.12.2.10 para.722; and
(c) withstand without rupture of the containment system the test specified in 6.4.12.2.16 para. 728.

6.4.6.3 [631.] Packages designed to contain 0.1 kg or more of uranium hexafluoride shall not be provided with pressure relief devices.

6.4.6.4 [632.] Subject to the approval of the competent authority, packages designed to contain 0.1 kg or more of uranium hexafluoride may be transported if:

(a) the packages are designed to requirements other than those given in ISO 7195 [10] and 6.4.6.2 and 6.4.6.3 paras 630-631 but, notwithstanding, the requirements of 6.4.6.2 and 6.4.6.3 paras 630-631 are met as far as practicable;
(b) the packages are designed to withstand without leakage and without unacceptable stress a test pressure less than 2.8 MPa as specified in 2.2.6 para. 718; or

(c) for packages designed to contain 9000 kg or more of uranium hexafluoride, the packages do not meet the requirement of 6.4.6.2(c) para. 630(c).

6.4.7 Requirements for Type A packages

6.4.7.1 [633M.] Type A packages shall be designed to meet the general requirements of this Chapter, the requirements of 6.4.3.1to 6.4.3.3 paras 617-619 if transported by air, and the following additional requirements:

6.4.7.2 [634.] The smallest overall external dimension of the package shall not be less than 10 cm.

6.4.7.3 [635.] The outside of the package shall incorporate a feature such as a seal, which is not readily breakable and which, while intact, will be evidence that it has not been opened.

6.4.7.4 [636.] Any tie-down attachments on the package shall be so designed that, under normal and accident conditions of transport, the forces in those attachments shall not impair the ability of the package to meet the requirements of these Regulations.

6.4.7.5 [637.] The design of the package shall take into account temperatures ranging from -40 C to +70 C for the components of the packaging. Attention shall be given to freezing temperatures for liquids and to the potential degradation of packaging materials within the given temperature range.

6.4.7.6 [638.] The design and manufacturing techniques shall be in accordance with national or international standards, or other requirements, acceptable to the competent authority.

6.4.7.7 [639.] The design shall include a containment system securely closed by a positive fastening device which cannot be opened unintentionally or by a pressure which may arise within the package.

6.4.7.8 [640.] Special form radioactive material may be considered as a component of the containment system.

6.4.7.9 [641.] If the containment system forms a separate unit of the package, it shall be capable of being securely closed by a positive fastening device which is independent of any other part of the packaging.

6.4.7.10 [642.] The design of any component of the containment system shall take into account, where applicable, the radiolytic decomposition of liquids and other vulnerable materials and the generation of gas by chemical reaction and radiolysis.

6.4.7.11 [643.] The containment system shall retain its radioactive contents under a reduction of ambient pressure to 60 kPa.

6.4.7.12 [644.] All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.

6.4.7.13 [645.] A radiation shield which encloses a component of the package specified as a part of the containment system shall be so designed as to prevent the unintentional release of that component from the shield. Where the radiation shield and such component within it form a separate unit, the radiation shield shall be capable of being securely closed by a positive fastening device which is independent of any other packaging structure.

6.4.7.14 [646.] A package shall be so designed that if it were subjected to the tests specified in 6.4.12.2.7 to 6.4.12.2.12 paras 719-724, it would prevent:

(a) Loss or dispersal of the radioactive contents; and
(b) Loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the package.

6.4.7.15 [647.] The design of a package intended for liquid radioactive material shall make provision for ullage to accommodate variations in the temperature of the contents, dynamic effects and filling dynamics.

Type A Packages to Contain Liquids

6.4.7.16 [648.] A Type A package designed to contain liquids shall, in addition:

(a) Be adequate to meet the conditions specified in 6.4.7.14 para. 646 above if the package is subjected to the tests specified in 6.4.12.2.13 para. 725; and

(b) Either
  (i) Be provided with sufficient absorbent material to absorb twice the volume of the liquid contents. Such absorbent material must be suitably positioned so as to contact the liquid in the event of leakage; or
  (ii) Be provided with a containment system composed of primary inner and secondary outer containment components designed to ensure retention of the liquid contents, within the secondary outer containment components, even if the primary inner components leak.

Type A Packages to Contain Gas

6.4.7.17 [649.] A package designed for gases shall prevent loss or dispersal of the radioactive contents if the package were subjected to the tests specified in 6.4.12.2.13para. 725. A Type A package designed for tritium gas or for noble gases shall be excepted from this requirement.

6.4.8 Requirements for Type B(U) packages

6.4.8.1 [650.] Type B(U) packages shall be designed to meet the requirements specified in 6.4.2.1to 6.4.2.10 paras 606-616, the requirements of 6.4.3.1to 6.4.3.3 paras 617-619 if carried by air, and of 6.4.7.2 to 6.4.7.15 paras 634-647, except as specified in 6.4.7.14(a) para. 646(a), and, in addition, the requirements specified in 6.4.8.2 to 6.4.8.15 paras 651-664.

6.4.8.2 [651.] A package shall be so designed that, under the ambient conditions specified in 6.4.8.4 and 6.4.8.5 paras 653 and 654, heat generated within the package by the radioactive contents shall not, under normal conditions of transport, as demonstrated by the tests in 6.4.12.2.7 to 6.4.12.2.12 paras 719-724, adversely affect the package in such a way that it would fail to meet the applicable requirements for containment and shielding if left unattended for a period of one week. Particular attention shall be paid to the effects of heat, which may:

(a) Alter the arrangement, the geometrical form or the physical state of the radioactive contents or, if the radioactive material is enclosed in a can or receptacle (for example, clad fuel elements), cause the can, receptacle or radioactive material to deform or melt; or

(b) Lessen the efficiency of the packaging through differential thermal expansion or cracking or melting of the radiation shielding material; or

(c) In combination with moisture, accelerate corrosion.

6.4.8.3 [652.] Except as required in 6.4.3.1 para. 617 for a package transported by air, a package shall be so designed that, under the ambient condition specified in 6.4.8.4para. 653, the temperature of the accessible surfaces of a package shall not exceed 50 °C, unless the package is transported under exclusive use.

6.4.8.4 [653.] The ambient temperature shall be assumed to be 38 °C.

6.4.8.5 [654.] The solar insolation conditions shall be assumed to be as specified in Table XI.

[Table XI from ST-1]

INSOLATION DATA

Form and location of surface	Insolation for 12 hours per day (W/m2)
Flat surfaces transported horizontally:	
-- base	none
-- other surfaces	800
Flat surfaces not transported horizontally:	
-- each surface	200[a]
Curved surfaces	400[a]

[a] Alternatively, a sine function may be used, with an absorption coefficient adopted and the effects of possible reflection from neighboring objects neglected.

6.4.8.6 [655.] A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in 6.4.12.2.16 para. 728 shall be so designed that such protection will remain effective if the package is subjected to the tests specified in paras 6.4.12.2.7-6.4.12.2.12 719-724 and 6.4.12.2.15(a) and (b) 727(a) and (b) or 6.4.12.2.15(b) and (c)727(b) and (c), as appropriate. Any such protection on the exterior of the package shall not be rendered ineffective by ripping, cutting, skidding, abrasion or rough handling.

6.4.8.7 [656.] A package shall be so designed that, if it were subjected to:

(a) The tests specified in 6.4.12.2.7-6.4.12.2.12 paras 719-724, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour; and

(b) The tests specified in paras 6.4.12.2.14, 6.4.12.2.15(b), 6.4.12.2.16, and 6.4.12.2.17 726, 727(b), 728 and 729 and the tests in

(i) 6.4.12.2.15(c) 727(c), when the package has a mass not greater than 500 kg, an overall density not greater than 1000 kg/m^3 based on the external dimensions, and radioactive contents greater than 1000 A_2 not as special form radioactive material, or

(ii) 6.4.12.2.15(a) 727(a), for all other packages,it would meet the following requirements:

(i)*(1)* retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain; and

(ii)*(2)* restrict the accumulated loss of radioactive contents in a period of one week to not more than 10 A_2 for krypton-85 and not more than A_2 for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2.7.7.2.4-2.7.7.2.6 paras 404-406 shall apply except that for krypton-85 an effective A_2(i) value equal to 10 A_2 may be used. For case (a) above, the assessment shall take into account the external contamination limits of 4.1.7.1.2 para. 508.

6.4.8.8 [657.] A package for radioactive contents with activity greater than 10^5 A_2 shall be so designed that if it were subjected to the enhanced water immersion test specified in 6.4.12.2.18 para. 730, there would be no rupture of the containment system.

6.4.8.9 [658.] Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system.

6.4.8.10 [659.] A package shall not include a pressure relief system from the containment system which would allow the release of radioactive material to the environment under the conditions of the tests specified in paras 6.4.12.2.7-6.4.12.2.12 719-724 and 726-729.

6.4.8.11 [660.] A package shall be so designed that if it were at the maximum normal operating pressure and it were subjected to the tests specified in 6.4.12.2.7-6.4.12.2.12 paras 719-724 and **6.4.12.2.14-6.4.12.2.17** 726-729, the level of strains in the containment system would not attain values which would adversely affect the package in such a way that it would fail to meet the applicable requirements.

6.4.8.12 [661.] A package shall not have a maximum normal operating pressure in excess of a gauge pressure of 700 kPa.

6.4.8.13 [662.] Except as required in 6.4.3.1 para. 617 for a package transported by air, the maximum temperature of any surface readily accessible during transport of a package shall not exceed 85 °C in the absence of insolation under the ambient conditions specified in 6.4.8.4 para. 653. The package shall be carried under exclusive use, as specified in 6.4.8.3 para. 652, if this maximum temperature exceeds 50 °C. Account may be taken of barriers or screens intended to give protection to persons without the need for the barriers or screens being subject to any test.

6.4.8.14 [663.] A package containing low dispersible radioactive material shall be so designed that any features added to the low dispersible radioactive material that are not part of it, or any internal components of the packaging shall not adversely affect the performance of the low dispersible radioactive material.

6.4.8.15 [664.] A package shall be designed for an ambient temperature range from -40 °C to +38 °C.

6.4.9 Requirements for Type B(M) packages

6.4.9.1 [665.] Type B(M) packages shall meet the requirements for Type B(U) packages specified in 6.4.8.1 para. 650, except that for packages to be transported solely within a specified country or solely between specified countries, conditions other than those given in 6.4.7.5, 6.4.8.4, 6.4.8.5, and 6.4.8.8-6.4.8.15 paras 637, 653, 654 and 657-664 above may be assumed with the approval of the competent authorities of these countries. Notwithstanding, the requirements for Type B(U) packages specified in 6.4.8.8-6.4.8.15 paras 657-664 shall be met as far as practicable.

6.4.9.2 [666.] Intermittent venting of Type B(M) packages may be permitted during transport, provided that the operational controls for venting are acceptable to the relevant competent authorities.

6.4.10 Requirements for Type C packages

6.4.10.1 [667.] Type C packages shall be designed to meet the requirements specified in 6.4.2.1-6.4.3.3 paras 606-619, and of 6.4.7.2-6.4.7.15 paras 634-647, except as specified in 6.4.7.14(a) para. 646(a), and of the requirements specified in 6.4.8.2-6.4.8.5 paras 651-654, paras 658-664, and, in addition, of 6.4.10.2-6.4.10.4 paras 668-670.

6.4.10.2 [668.] A package shall be capable of meeting the assessment criteria prescribed for tests in 6.4.8.7(b) and 6.4.8.11 paras 656(b) and 660 after burial in an environment defined by a thermal conductivity of 0.33 W/m.K and a temperature of 38°C in the steady state. Initial conditions for the assessment shall assume that any thermal insulation of the package remains intact, the package is at the maximum normal operating pressure and the ambient temperature is 38°C.

6.4.10.3 [669.] A package shall be so designed that, if it were at the maximum normal operating pressure and subjected to:

(a) the tests specified in 6.4.12.2.7-6.4.12.2.12 paras 719-724, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour; and

(b) the test sequences in 6.4.12.2.22 para. 734, it would meet the following requirements:

  (i) retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain; and

  (ii) restrict the accumulated loss of radioactive contents in a period of 1 week to not more than 10 A_2 for krypton-85 and not more than A_2 for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2.7.7.2.4-2.7.7.2.6 paras 404-406 shall apply except that for krypton-85 an effective A_2(i) value equal to 10 A_2 may be used. For case (a) above, the assessment shall take into account the external contamination limits of 4.1.7.1.2 para. 508.

6.4.10.4 [670.] A package shall be so designed that there will be no rupture of the containment system following performance of the enhanced water immersion test specified in 6.4.12.2.18 para. 730.

6.4.11 Requirements for packages containing fissile material

6.4.11.1 [671.] Fissile material shall be transported so as to;

(a) maintain subcriticality during normal and accident conditions of transport; in particular, the following contingencies shall be considered:

  (i) water leaking into or out of packages;

  (ii) the loss of efficiency of built-in neutron absorbers or moderators;

  (iii) rearrangement of the contents either within the package or as a result of loss from the package;

  (iv) reduction of spaces within or between packages;

  (v) packages becoming immersed in water or buried in snow; and

  (vi) temperature changes; and

(b) meet the requirements:

  (i) of 6.4.7.2 para. 634 for fissile material contained in packages;

  (ii) prescribed elsewhere in these Regulations which pertain to the radioactive properties of the material; and

(iii) specified in 6.4.11.3-6.4.11.12 paras 673-682, unless excepted by 6.4.11.12para. 672.

6.4.11.2 [672.] Fissile material meeting one of the provisions (a)-(d) of this paragraph is excepted from the requirement to be transported in packages that comply with 6.4.11.3-6.4.11.12 paras 673-682 as well as the other requirements of these Regulations that apply to fissile material. Only one type of exception is allowed per consignment.

(a) A mass limit per consignment such that:

$$\frac{mass\ of\ uranium\text{-}235\ (g)}{X} + \frac{mass\ of\ other\ fissile\ material\ (g)}{Y} < 1$$

where X and Y are the mass limits defined in Table XII, provided that either

(i) each individual package contains not more than 15 g of fissile material; for unpackaged material, this quantity limitation shall apply to the consignment being carried in or on the conveyance, or

(ii) the fissile material is a homogeneous hydrogenous solution or mixture where the ratio of fissile nuclides to hydrogen is less than 5% by mass, or

(iii) there is not more than 5 g of fissile material in any 10 litre volume of material.

Neither beryllium nor deuterium shall be present in quantities exceeding 0.1% of the fissile material mass.

(b) Uranium enriched in uranium-235 to a maximum of 1% by mass, and with a total plutonium and uranium-233 content not exceeding 1% of the mass of uranium-235, provided that the fissile material is distributed essentially homogeneously throughout the material. In addition, if uranium-235 is present in metallic, oxide or carbide forms, it shall not form a lattice arrangement.

(c) Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2% by mass, with a total plutonium and uranium-233 content not exceeding 0.002% of the mass of uranium, and with a minimum nitrogen to uranium atomic ratio (N/U) of 2.

(d) Packages containing, individually, a total plutonium mass not more than 1 kg, of which not more than 20% by mass may consist of plutonium-239, plutonium-241 or any combination of those radionuclides.

[Table XII from ST-1]

CONSIGNMENT MASS LIMITS FOR EXCEPTIONS FROM THE REQUIREMENTS FOR PACKAGES CONTAINING FISSILE MATERIAL

Fissile material	*Fissile material* mass (g) mixed with substances having an average hydrogen density less than or equal to water	*Fissile material* mass (g) mixed with substances having an average hydrogen density greater than water
Uranium - 235 (X)	400	290
Other *fissile material* (Y)	250	180

6.4.11.3 [673.] Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of 6.4.11.7-6.4.11.12 paras 677-682 shall be performed assuming that each parameter that is not known has the value which gives the maximum neutron multiplication consistent with the known conditions and parameters in these assessments.

6.4.11.4 [674.] For irradiated nuclear fuel the assessments of 6.4.11.7-6.4.11.12 paras 677-682 shall be based on an isotopic composition demonstrated to provide:

(a) the maximum neutron multiplication during the irradiation history, or

(b) a conservative estimate of the neutron multiplication for the package assessments. After irradiation but prior to shipment, a measurement shall be performed to confirm the conservatism of the isotopic composition.

6.4.11.5 [675.] The packaging, after being subjected to the tests specified in 6.4.12.2.7-6.4.12.2.12 paras 719-724, must prevent the entry of a 10 cm cube.

6.4.11.6 [676.] The package shall be designed for an ambient temperature range of -40°C to +38°C unless the competent authority specifies otherwise in the certificate of approval for the package design.

6.4.11.7 [677.] For a package in isolation, it shall be assumed that water can leak into or out of all void spaces of the package, including those within the containment system. However, if the design incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of error, absence of leakage may be assumed in respect of those void spaces. Special features shall include the following:

(a) Multiple high standard water barriers, each of which would remain watertight if the package were subject to the tests prescribed in 6.4.11.12(b) para. 682(b), a high degree of quality control in the manufacture, maintenance and repair of packagings and tests to demonstrate the closure of each package before each shipment; or

(b) For packages containing uranium hexafluoride only:

  (i) packages where, following the tests prescribed in 6.4.11.12(b) para. 682(b), there is no physical contact between the valve and any other component of the packaging other than at its original point of attachment and where, in addition, following the test prescribed in 6.4.12.2.16 para. 728 the valves remain leaktight; and

  (ii) a high degree of quality control in the manufacture, maintenance and repair of packagings coupled with tests to demonstrate closure of each package before each shipment.

6.4.11.8 [678.] It shall be assumed that the confinement system shall be closely reflected by at least 20 cm of water or such greater reflection as may additionally be provided by the surrounding material of the packaging. However, when it can be demonstrated that the confinement system remains within the packaging following the tests prescribed in 6 4.11.12(b) para. 682(b), close reflection of the package by at least 20 cm of water may be assumed in 6.4.11.9(c)para.679(c).

6.4.11.9 [679.] The package shall be subcritical under the conditions of 6.4.11.7 and 6.4.11.8 paras 677 and 678 and with the package conditions that result in the maximum neutron multiplication consistent with:

(a) routine conditions of transport (incident free);
(b) the tests specified in 6.4.11.11(b) para. 681(b);
(c) the tests specified in 6.4.11.12(b) para. 682(b).

6.4.11.10 [680]. For packages to be transported by air:

(a) the package shall be subcritical under conditions consistent with the tests prescribed in 6.4.12.2.22 para. 734 assuming reflection by at least 20cm of water but no water inleakage; and
(b) allowance shall not be made for special features of para. 677 unless, following the tests specified in 6.4.12.2.22 para. 734 and, subsequently,6.4.12.2.21 para. 733, leakage of water into or out of the void spaces is prevented.

6.4.11.11 [681.] A number "N" shall be derived, such that five times "N" shall be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

(a) There shall not be anything between the packages, and the package arrangement shall be reflected on all sides by at least 20 cm of water; and
(b) The state of the packages shall be their assessed or demonstrated condition if they had been subjected to the tests specified in 6.4.12.2.7 to 6.4.12.2.12 paras 719-724.

6.4.11.12 [682.] A number "N" shall be derived, such that two times "N" shall be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

(a) Hydrogenous moderation between packages, and the package arrangement reflected on all sides by at least 20 cm of water; and
(b) The tests specified in 6.4.12.2.7 to 6.4.12.2.12 paras 719-724 followed by whichever of the following is the more limiting:
    (i) the tests specified in 6.4.12.2.15(b) para. 727(b) and, either 6.4.12.2.15(c) para. 727(c) for packages having a mass not greater than 500 kg and an overall density not greater than 1000 kg/m^3 based on the external dimensions, or 6.4.12.2.15(a) para. 727(a) for all other packages; followed by the test specified in 6.4.12.2.16 para. 728 and completed by the tests specified in 6.4.12.2.19 to 6.4.12.2.19 paras 731-733; or
    (ii) the test specified in 6.4.12.2.17 para. 729; and
(c) Where any part of the fissile material escapes from the containment system following the tests specified in 6.4.11.12(b) para. 682(b), it shall be assumed that fissile material escapes from each package in the array and all of the fissile material shall be arranged in the configuration and moderation that results in the maximum neutron multiplication with close reflection by at least 20 cm of water.

6.4.12 Test procedures

Demonstration of compliance

6.4.12.1 [701.] Demonstration of compliance with the performance standards required in Section VI shall be accomplished by any of the methods listed below or by a combination thereof.

(a) Performance of tests with specimens representing LSA-III material, or special form radioactive material, or low dispersible radioactive material or with prototypes or samples of the packaging, where the contents of the specimen or the packaging for the tests shall simulate as closely as practicable the expected range of radioactive contents and the specimen or packaging to be tested shall be prepared as presented for transport.

(b) Reference to previous satisfactory demonstrations of a sufficiently similar nature.

(c) Performance of tests with models of appropriate scale incorporating those features which are significant with respect to the item under investigation when engineering experience has shown results of such tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as penetrator diameter or compressive load, shall be taken into account.

(d) Calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

6.4.12.1.2 [702.] After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment shall be used to assure that the requirements of this section have been fulfilled in compliance with the performance and acceptance standards prescribed in Section VI.

6.4.12.1.3 [713.] All specimens shall be inspected before testing in order to identify and record faults or damage including the following:

(a) divergence from the design;
(b) defects in manufacture;
(c) corrosion or other deterioration; and
(d) distortion of features.

6.4.12.2 Tests for packages

6.4.12.2.1

6.4.12.2.2 [714.] The containment system of the package shall be clearly specified.

6.4.12.2.3 [715.] The external features of the specimen shall be clearly identified so that reference may be made simply and clearly to any part of such specimen.

6.4.12.2.4 [716.] After each of the applicable tests specified in 6.4.12.2.6 to 6.4.12.2.25 paras 718 to 737:

(a) Faults and damage shall be identified and recorded;

(b) It shall be determined whether the integrity of the containment system and shielding has been retained to the extent required in Section VI for the package under test; and

(c) For packages containing fissile material, it shall be determined whether the assumptions and conditions used in the assessments required by 6.4.11.1 to 6.4.11.12 paras 671-682 for one or more packages are valid.

6.4.12.2.5 [717.] The target for the drop tests specified in 2.7.4.5(a),6.4.12.2.10,6.4.12.2.13(a), 6.4.12.2.15,6.4.12.2.23, and 6.4.12.2.25 paras 705, 722, 725(a), 727, 735 and 737 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

6.4.12.2.6 [718.] Specimens that comprise or simulate packagings designed to contain 0.1 kg or more of uranium hexafluoride shall be tested hydraulically at an internal pressure of at least 1.4 MPa but, when the test pressure is less than 2.8 MPa, the design shall require multilateral approval. For retesting packagings, any other equivalent non-destructive testing may be applied subject to multilateral approval.

6.4.12.2.7 [719.] The tests are: the water spray test, the free drop test, the stacking test and the penetration test. Specimens of the package shall be subjected to the free drop test, the stacking test and the penetration test, preceded in each case by the water spray test. One specimen may be used for all the tests, provided that the requirements of 6.4.12.2.8 para. 720 are fulfilled.

6.4.12.2.8 [720.] The time interval between the conclusion of the water spray test and the succeeding test shall be such that the water has soaked in to the maximum extent, without appreciable drying of the exterior of the specimen. In the absence of any evidence to the contrary, this interval shall be taken to be two hours if the water spray is applied from four directions simultaneously. No time interval shall elapse, however, if the water spray is applied from each of the four directions consecutively.

6.4.12.2.9 [721.] Water spray test: The specimen shall be subjected to a water spray test that simulates exposure to rainfall of approximately 5 cm per hour for at least one hour.

6.4.12.2.10 [722.] Free drop test: The specimen shall drop onto the target so as to suffer maximum damage in respect of the safety features to be tested.

(a) The height of drop measured from the lowest point of the specimen to the upper surface of the target shall be not less than the distance specified in Table XIII for the applicable mass. The target shall be as defined in 6.4.12.2.5 para. 717.

(b) For rectangular fibreboard or wood packages not exceeding a mass of 50 kg, a separate specimen shall be subjected to a free drop onto each corner from a height of 0.3 m.

(c) For cylindrical fibreboard packages not exceeding a mass of 100 kg, a separate specimen shall be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m.

[Table XIII from ST-1]

TABLE XIII FREE DROP DISTANCE FOR TESTING PACKAGES TO NORMAL CONDITIONS OF TRANSPORT

Package mass (kg)	Free drop distance (m)
package mass < 5 000	1.2
5 000 ≤ *package* mass < 10 000	0.9
10 000 ≤ *package* mass < 15 000	0.6
15 000 ≤ *package* mass	0.3

6.4.12.2.11 [723.] Stacking test: Unless the shape of the packaging effectively prevents stacking, the specimen shall be subjected, for a period of 24 h, to a compressive load equal to the greater of the following:

(a) The equivalent of 5 times the mass of the actual package; and
(b) The equivalent of 13 kPa multiplied by the vertically projected area of the package.

The load shall be applied uniformly to two opposite sides of the specimen, one of which shall be the base on which the package would typically rest.

6.4.12.2.12 [724.] Penetration test: The specimen shall be placed on a rigid, flat, horizontal surface which will not move significantly while the test is being carried out.

(a) A bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg shall be dropped and directed to fall, with its longitudinal axis vertical, onto the centre of the weakest part of the specimen, so that, if it penetrates sufficiently far, it will hit the containment system. The bar shall not be significantly deformed by the test performance.
(b) The height of drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen shall be 1 m.

6.4.12.2.13 [725.] A specimen or separate specimens shall be subjected to each of the following tests unless it can be demonstrated that one test is more severe for the specimen in question than the other, in which case one specimen shall be subjected to the more severe test.

(a) Free drop test: The specimen shall drop onto the target so as to suffer the maximum damage in respect of containment. The height of the drop measured from the lowest part of the specimen to the upper surface of the target sall be 9 m. The target shall be as defined in 6.4.12.2.5para.717.
(b) Penetration test: The specimen shall be subjected to the test specified in 6.4.12.2.12 para. 724 except that the height of drop shall be increased to 1.7 m from the 1 m specified in para. 6.4.12.2.12(b) 724(b).

6.4.12.2.14 [726.] The specimen shall be subjected to the cumulative effects of the tests specified in 6.4.12.2.15 para. 727 and 6.4.12.2.16 para. 728, in that order. Following these tests, either this specimen or a separate specimen shall be subjected to the effect(s) of the water immersion test(s) as specified in 6.4.12.2.17para. 729 and, if applicable,6.4.12.2.18para. 730.

6.4.12.2.15 [727.] Mechanical test: The mechanical test consists of three different drop tests. Each specimen shall be subjected to the applicable drops as specified in 6.4.8.7 para. 656 or 6.4.11.12 para. 682. The order in which the specimen is subjected to the drops shall be such that, on completion of the mechanical test, the specimen shall have suffered such damage as will lead to the maximum damage in the thermal test which follows.

(a) For drop I, the specimen shall drop onto the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the specimen to the upper surface of the target shall be 9 m. The target shall be as defined in 6.4.12.2.5 para. 717.

(b) For drop II, the specimen shall drop so as to suffer the maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the specimen to the upper surface of the bar shall be 1 m. The bar shall be of solid mild steel of circular section, (15.0 $\pm$ 0.5) cm in diameter and 20 cm long unless a longer bar would cause greater damage, in which case a bar of sufficient length to cause maximum damage shall be used. The upper end of the bar shall be flat and horizontal with its edges rounded off to a radius of not more than 6 mm. The target on which the bar is mounted shall be as described in 6.4.12.2.5para. 717.

(c) For drop III, the specimen shall be subjected to a dynamic crush test by positioning the specimen on the target so as to suffer maximum damage by the drop of a 500 kg mass from 9 m onto the specimen. The mass shall consist of a solid mild steel plate 1 m by 1 m and shall fall in a horizontal attitude. The height of the drop shall be measured from the underside of the plate to the highest point of the specimen. The target on which the specimen rests shall be as defined in 6.4.12.2.5para. 717.

6.4.12.2.16 [728.] Thermal test: The specimen shall be in thermal equilibrium under conditions of an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table XI and subject to the design maximum rate of internal heat generation within the package from the radioactive contents. Alternatively, any of these parameters are allowed to have different values prior to and during the test, providing due account is taken of them in the subsequent assessment of package response.

The thermal test shall then consist of:

(a) Exposure of a specimen for a period of 30 minutes to a thermal environment which provides a heat flux at least equivalent to that of a hydrocarbon fuel/air fire in sufficiently quiescent ambient conditions to give a minimum average flame emissivity coefficient of 0.9 and an average temperature of at least 800°C, fully engulfing the specimen, with a surface absorptivity coefficient of 0.8 or that value which the package may be demonstrated to possess if exposed to the fire specified, followed by;

(b) Exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table XI and subject to the design maximum rate of internal heat generation within the package by the radioactive contents for a sufficient period to ensure that temperatures in the specimen are everywhere decreasing and/or are approaching initial steady state conditions. Alternatively, any of these parameters are allowed to have different values following cessation of heating, providing due account is taken of them in the subsequent assessment of package response.

During and following the test the specimen shall not be artificially cooled and any combustion of materials of the specimen shall be permitted to proceed naturally.

6.4.12.2.17 [729.] Water immersion test: The specimen shall be immersed under a head of water of at least 15 m for a period of not less than eight hours in the attitude which will lead to maximum damage. For demonstration purposes, an external gauge pressure of at least 150 kPa shall be considered to meet these conditions.

6.4.12.2.18 [730.] Enhanced water immersion test: The specimen shall be immersed under a head of water of at least 200 m for a period of not less than one hour. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.

6.4.12.2.19 [731.] Packages for which water in-leakage or out-leakage to the extent which results in greatest reactivity has been assumed for purposes of assessment under 6.4.11.7 to 6.4.11.12paras 677-682 shall be excepted from the test.

6.4.12.2.20 [732.] Before the specimen is subjected to the water leakage test specified below, it shall be subjected to the tests in para. 727(b), and either para. 727(a) or (c) as required by para. 682, and the test specified in para. 728.

6.4.12.2.21 [733.] The specimen shall be immersed under a head of water of at least 0.9 m for a period of not less than eight hours and in the attitude for which maximum leakage is expected.

6.4.12.2.22 [734.] Specimens shall be subjected to the effects of each of the following test sequences in the orders specified:

(a) the tests specified in 6.4.12.2.15(a), 6.4.12.2.15(c), 6.4.12.2.23 and 6.4.12.2.24; paras 727(a), 727(c), 735 and 736; and

(b) the test specified in 6.4.12.2.25 para. 737.

Separate specimens are allowed to be used for each of the sequences (a) and (b).

6.4.12.2.23 [735.] Puncture/tearing test: The specimen shall be subjected to the damaging effects of a solid probe made of mild steel. The orientation of the probe to the surface of the specimen shall be as to cause maximum damage at the conclusion of the test sequence specified in 6.4.12.2.22(a) para. 734(a).

(a) The specimen, representing a package having a mass less than 250 kg, shall be placed on a target and subjected to a probe having a mass of 250 kg falling from a height of 3 m above the intended impact point. For this test the probe shall be a 20 cm diameter cylindrical bar with the striking end forming a frustum of a right circular cone with the following dimensions: 30 cm height and 2.5 cm in diameter at the top. The target on which the specimen is placed shall be as specified in 6.4.12.2.5 para. 717.

(b) For packages having a mass of 250 kg or more, the base of the probe shall be placed on a target and the specimen dropped onto the probe. The height of the drop , measured from the point of impact with the specimen to the upper surface of the probe shall be 3 m. For this test the probe shall have the same properties and dimensions as specified in (a) above, except that the length and mass of the probe shall be such as to incur maximum damage to the specimen. The target on which the base of the probe is placed shall be as specified in 6.4.12.2.5 para. 717.

6.4.12.2.24 [736.] Enhanced thermal test: The conditions for this test shall be as specified in 6.4.12.2.16 para. 728, except that the exposure to the thermal environment shall be for a period of 60 minutes.

6.4.12.2.25 [737.] Impact test: The specimen shall be subject to an impact on a target at a velocity of not less than 90 m/s, at such an orientation as to suffer maximum damage. The target shall be as defined in 6.4.12.2.5para. 717.

6.4.13 Approvals of package designs and materials

6.4.13.1 [805M] The approval of designs for packages containing 0.1 kg or more of uranium hexafluoride requires that:

(a) After 31 December 2000, each design that meets the requirements of 6.4.6.4 para. 632 shall require multilateral approval.
(b) After 31 December 2003, each design that meets the requirements of 6.4.6.1 to 6.4.6.3 paras 629-631 shall require unilateral approval by the competent authority of the country of origin of the design;

6.4.13.2 [806.] Each Type B(U) and Type C package design shall require unilateral approval, except that:

(a) a package design for fissile material, which is also subject to 6.4.13.4 paras 812-814, shall require multilateral approval; and
(b) a Type B(U) package design for low dispersible radioactive material shall require multilateral approval.

6.4.13.3 [809.] Each Type B(M) package design, including those for fissile material which are also subject to 6.4.13.4 paras 812-814 and those for low dispersible radioactive material, shall require multilateral approval.

6.4.13.4 [812.] Each package design for fissile material which is not excepted according to 6.4.11.2 para. 672 from the requirements that apply specifically to packages containing fissile material shall require multilateral approval.

6.4.13.5[803M.] The design for special form radioactive material shall require unilateral approval. The design for low dispersible radioactive material shall require multilateral approval.

6.4.14 Transitional measures for Class 7

6.4.14.1 Packages not requiring competent authority approval of design under the 1985 and 1985 (as amended 1990) editions of IAEA Safety Series No. 6

[815.] Excepted packages, Industrial packages Type IP-1, Type IP-2 and Type IP-3 and Type A packages that did not require approval of design by the competent authority and which meet the requirements of the 1985 or 1985 (As Amended 1990) Editions of these Regulations *IAEA Regulations for the Safe Transport of Radioactive Material (IAEA Safety Series No. 6)* may continue to be used subject to the mandatory programme of quality assurance in accordance with the requirements of 1.1.2.2 para. 310 and the activity limits and material restrictions of 2.7.7 Section IV. Any packaging modified, unless to improve safety, or manufactured after 31 December 2003, shall meet this Edition of the Regulations *the requirements of these Regulations* in full. Packages prepared for transport not later than 31 December 2003 under the 1985 or 1985 (As amended 1990) Editions of these Regulations *IAEA Safety Series No. 6* may continue in transport. Packages prepared for transport after this date shall meet this Edition *the requirements of these* Regulations in full.

Packages approved under the 1973, 1973 (as amended), 1985 and 1985 (as amended 1990) editions of IAEA Safety Series No. 6

6.4.14.2 [816.] Packagings manufactured to a package design approved by the competent authority under the provisions of the 1973 or 1973 (As Amended) Editions of these Regulations *IAEA Safety Series No. 6* may continue to be used, subject to: multilateral approval of package design, the mandatory programme of quality assurance in accordance with the applicable requirements of 1.1.2.2. para. 310; the activity limits and material restrictions of 2.7.7 Section IV; and, for a package containing fissile material and transported by air, the requirement of 6.4.11.10 para. 680. No new manufacture of such packaging shall be permitted to commence. Changes in the design of the packaging or in the nature or quantity of the authorized radioactive contents which, as determined by the competent authority, would significantly affect safety shall require that this Edition of the Regulations the *requirements of these Regulations* be met in full. A serial number according to the provision of 5.2.1.5.5 para. 538 shall be assigned to and marked on the outside of each packaging.

6..4.14.3 [817.] Packagings manufactured to a package design approved by the competent authority under the provisions of the 1985 or 1985 (As Amended 1990) Editions of these Regulations *IAEA Safety Series No. 6* may continue to be used until 31 December 2003, subject to: the mandatory programme of quality assurance in accordance with the requirements of 1.1.2.2 para. 310; the activity limits and material restrictions of 2.7.7 Section IV; and, for a package containing fissile material and transported by air, the requirement of 6.4.11.10 para. 680. After this date use may continue subject, additionally, to multilateral approval of package design. Changes in the design of the packaging or in the nature or quantity of the authorized radioactive contents which, as determined by the competent authority, would significantly affect safety shall require that this Edition *the requirements of these* Regulations be met in full. All packagings for which manufacture begins after 31 December 2006 shall meet this Edition *the requirements of these* Regulations in full.

6.4.14.4 Special form radioactive material approved under the 1973, 1973 (As Amended), 1985 and 1985 (As Amended 1990) Editions of these Regulations *editions of IAEA Safety Series No. 6*

[818.] Special form radioactive material manufactured to a design which had received unilateral approval by the competent authority under the 1973, 1973 (As Amended), 1985 or 1985 (As Amended 1990) Editions of these Regulations *IAEA Safety Series No. 6* may continue to be used when in compliance with the mandatory programme of quality assurance in accordance with the applicable requirements of 1.1.2.2 para. 310. All special form radioactive material manufactured after 31 December 2003 shall meet this Edition *the requirements of these* Regulations in full.

PART 7

Provisions concerning transport operations

Chapter 7.1 - Provisions concerning transport operations by all modes of transport

7.1.6 Special provisions applicable to the carriage of radioactive materials

7.1.6.1 Segregation

7.1.6.1.1 [306.] Radioactive material shall be segregated sufficiently from workers and from members of the public. The following values for dose shall be used for the purpose of calculating segregation distances or radiation levels:

(a) for workers in regularly occupied working areas a dose of 5 mSv in a year;
(b) for members of the public, in areas where the public has regular access, a dose of 1 mSv in a year to the critical group.

7.1.6.1.2 [563.] Category II-YELLOW or III-YELLOW packages or overpacks shall not be carried in compartments occupied by passengers, except those exclusively reserved for couriers specially authorized to accompany such packages or overpacks.

7.1.6.1.3 [307.] Radioactive material shall be sufficiently segregated from undeveloped photographic film. The basis for determining segregation distances for this purpose shall be that the radiation exposure of undeveloped photographic film due to the transport of radioactive material be limited to 0.1 mSv per consignment of such film.

7.1.6.2 Activity Limits

[525.] The total activity in a single hold or compartment of an inland water craft, or in another conveyance, for carriage of LSA material or SCO in Type IP-1, Type IP-2, Type IP-3 or unpackaged, shall not exceed the limits shown in Table V.

[Table V from ST-1]

CONVEYANCE ACTIVITY LIMITS FOR LSA MATERIAL AND SCO IN INDUSTRIAL PACKAGES OR UNPACKAGED

Nature of material	Activity limit for *conveyances* other than By inland waterway	Activity limit for a hold or compartment of an inland water craft
LSA-I	No limit	No limit
LSA-II and LSA-III non-combustible solids	No limit	100 A_2
LSA-II and LSA-III combustible solids, and all liquids and gases	100 A_2	10 A_2
SCO	100 A_2	10 A_2

7.1.6.3 Stowage during transport and storage in transit

7.1.6.3.1 [564.] Consignments shall be securely stowed.

7.1.6.3.2 [565.] Provided that its average surface heat flux does not exceed 15 W/m^2 and that the immediately surrounding cargo is not in sacks or bags, a package or overpack may be carried or stored among packaged general cargo without any special stowage provisions except as may be specifically required by the competent authority in an applicable approval certificate.

7.1.6.3.3 [566.] Loading of freight containers and accumulation of packages, overpacks and freight containers shall be controlled as follows:

(a) Except under the condition of exclusive use, the total number of packages, overpacks and freight containers aboard a single conveyance shall be so limited that the total sum of the transport indexes aboard the conveyance does not exceed the values shown in Table IX. For consignments of LSA-I material there shall be no limit on the sum of the transport indexes.

(b) Where a consignment is transported under exclusive use, there shall be no limit on the sum of the transport indexes aboard a single conveyance.

(c) The radiation level under routine conditions of transport shall not exceed 2 mSv/h at any point on, and 0.1 mSv/h at 2 m from, the external surface of the conveyance.

(d) The total sum of the criticality safety indexes in a freight container and aboard a conveyance shall not exceed the values shown in Table X.

{Table IX from ST-1}

TI LIMITS FOR FREIGHT CONTAINERS AND CONVEYANCES NOT UNDER EXCLUSIVE USE

Type of *freight container* or *conveyance*	Limit on total sum of *transport indexes* in a *freight container* or aboard a *conveyance*
Freight container -- Small	50
Freight container -- Large	50
Vehicle	50
Aircraft	
Passenger	50
Cargo	200
Inland water-way *vessel*	50
Seagoing *vessel*[a]	
(1) Hold, compartment or *defined deck area*	
Packages, overpacks, small *freight containers*	50
Large *freight containers*	200
(2) Total *vessel*	
Packages, overpacks, small *freight containers*	200
Large *freight containers*	No limit

[a] *Packages* or *overpacks* carried in or on a vehicle are in accordance with the provisions of ~~para~~ ~~572~~ 7.2.3.1.3 may be transported by vessels provided that they are no removed from the vehicle at any time while on board the vessel.

[Table X from ST-1]

CSI LIMITS FOR FREIGHT CONTAINERS AND CONVEYANCES CONTAINING FISSILE MATERIAL

Type of *freight container* or *conveyance*	Limit on total sum of *criticality safety indexes* in a *freight container* or aboard a *conveyance*	
	Not under *exclusive use*	Under *exclusive use*
Freight container -- Small	50	n.a.
Freight container -- Large	50	100
Vehicle	50	100
Aircraft		
Passenger	50	n.a.
Cargo	50	100
Inland water-way *vessel*	50	100
Seagoing *vessel* [a]		
(1) Hold, compartment or *defined deck area*		
Packages, overpacks, small *freight containers*	50	100
Large *freight containers*	50	100
(2) Total *vessel*		
Packages, overpacks, small *freight containers*	200[b]	200[c]
Large *freight containers*	No limit[b]	No limit[c]

[a] *Packages* of *overpacks* carried in or on a *vehicle* which are in accordance with the provisions of para. 572 7.2.3.1.3 may be transported by vessels provided that they are not removed from the vehicle at any time while on board the vessel. In that case the entries under the heading *'under exclusive use'* apply.

[b] The *consignment* shall be so handled and stowed that the total sum of *CSI's* in any group does not exceed 50, and that each group is handled and stowed so that the groups are separated from each other by at least 6 m.

[c] The *consignment* shall be so handled and stowed that the total sum of *CSI's* in any group does not exceed 100, and that each group is handled and stowed so that the groups are separated from each other by at least 6 m. *For transport under exclusive use*, the intervening space between groups may be occupied by other *compatible* cargo~~in accordance with para. 505~~.

7.1.6.3.4 [567.] Any package or overpack having either a transport index greater than 10, or any consignment having a criticality safety index greater than 50, shall be transported only under exclusive use.

7.1.6.4 Segregation of packages containing fissile material during transport and storage in transit

7.1.6.4.1 [568.] The number of packages, overpacks and freight containers containing fissile material stored in transit in any one storage area shall be so limited that the total sum of the criticality safety indexes in any group of such packages, overpacks or freight containers does not exceed 50. Groups of such packages, overpacks and freight containers shall be stored so as to maintain a spacing of at least 6 m from other groups of such packages, overpacks or freight containers.

7.1.6.4.2 [569.] Where the total sum of the criticality safety indexes on board a conveyance or in a freight container exceeds 50, as permitted in Table X, storage shall be such as to maintain a spacing of at least 6 m from other groups of packages, overpacks or freight containers containing fissile material or other conveyances carrying radioactive material.

7.1.6.5 Damaged or leaking packages, contaminated packagings

7.1.6.5.1 [510.] If it is evident that a package is damaged or leaking, or if it is suspected that the package may have leaked or been damaged, access to the package shall be restricted and a qualified person shall, as soon as possible, assess the extent of contamination and the resultant radiation level of the package. The scope of the assessment shall include the package, the conveyance, the adjacent loading and unloading areas, and, if necessary, all other material which has been carried in the conveyance. When necessary, additional steps for the protection of persons property and the environment, in accordance with provisions established by the relevant competent authority, shall be taken to overcome and minimize the consequences of such leakage or damage.

7.1.6.5.2 [511.] Packages damaged or leaking radioactive contents in excess of allowable limits for normal conditions of transport may be removed to an acceptable interim location under supervision, but shall not be forwarded until repaired or reconditioned and decontaminated.

7.1.6.5.3 [512.] A conveyance and equipment used regularly for the transport of radioactive material shall be periodically checked to determine the level of contamination. The frequency of such checks shall be related to the likelihood of contamination and the extent to which radioactive material is transported.

7.1.6.5.4 [513.] Except as provided in 7.1.6.5.5 para. 514, any conveyance, or equipment or part thereof which has become contaminated above the limits specified in 4.1.7.1.2 para. 508 in the course of the transport of radioactive material, or which shows a radiation level in excess of 5 μSv/h at the surface, shall be decontaminated as soon as possible by a qualified person and shall not be re-used unless the non-fixed contamination does not exceed the limits specified in 4.1.7.1.2 para. 508, and the radiation level resulting from the fixed contamination on surfaces after decontamination is less than 5 μSv/h at the surface.

7.1.6.5.5[514.] An overpack, freight container, tank, intermediate bulk container or conveyance dedicated to the transport of radioactive material under exclusive use shall be excepted from the requirements of 4.1.7.1.4 paras 509 and 7.1.6.5.4 513 solely with regard to its internal surfaces and only for as long as it remains under that specific exclusive use.

7.1.6.5 Other requirements

7.1.6.5.1 [582.] Where a consignment is undeliverable, the consignment shall be placed in a safe location and the appropriate competent authority shall be informed as soon as possible and a request made for instructions on further action.

Chapter 7.2 - Modal Provisions

7.2.3 Special provisions applicable to the carriage of radioactive materials

7.2.3.1 Transport by Rail and by Road

7.2.3.1.1 [570.] Rail and road vehicles carrying packages, overpacks or freight containers labelled with any of the labels shown in Fig. 2, Fig. 3, Fig. 4 or Fig. 5, or carrying consignments under exclusive use, shall display the placard shown in Fig. 6 on each of:

(a) The two external lateral walls in the case of a rail vehicle;
(b) The two external lateral walls and the external rear wall in the case of a road vehicle.

In the case of a vehicle without sides the placards may be affixed directly on the cargo-carrying unit provided that they are readily visible; in the case of physically large tanks or freight containers, the placards on the tanks or freight containers shall suffice. In the case of vehicles which have insufficient area to allow the fixing of larger placards, the dimensions of the placard as described in Fig. 6 may be reduced to 100 mm. Any placards which do not relate to the contents shall be removed.

7.2.3.1.2 [571M.] Where the consignment in or on the vehicle is unpackaged LSA-I material or SCO-I or where an exclusive use consignment is packaged radioactive material with a single United Nations number, the appropriate United Nations number shall also be displayed, in black digits not less than 65 mm high, either:

(a) In the lower half of the placard shown in Fig. 6, preceded by the letters "UN" and against the white background, or
(b) On the placard shown in Fig. 7.

When the alternative given in (b) above is used, the subsidiary placard shall be affixed immediately adjacent to the main placard, either on the two external lateral walls in the case of a rail vehicle or the two external lateral walls and the external rear wall in the case of a road vehicle.

7.2.3.1.3 [572.] For consignments under exclusive use, the radiation level shall not exceed:

(a) 10 mSv/h at any point on the external surface of any package or overpack, and may only exceed 2 mSv/h provided that:
    (i) the vehicle is equipped with an enclosure which, during routine conditions of transport, prevents the access of unauthorized persons to the interior of the enclosure, and
    (ii) provisions are made to secure the package or overpack so that its position within the vehicle remains fixed during routine conditions of transport, and
    (iii) there is no loading or unloading during the shipment;

(b) 2 mSv/h at any point on the outer surfaces of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the vehicle; and

(c) 0.1 mSv/h at any point 2 m from the vertical planes represented by the outer lateral surfaces of the vehicle, or, if the load is transported in an open vehicle, at any point 2 m from the vertical planes projected from the outer edges of the vehicle.

7.2.3.1.4 [573.] In the case of road vehicles, no persons other than the driver and assistants shall be permitted in vehicles carrying packages, overpacks or freight containers bearing category II-YELLOW or III-YELLOW labels.

7.2.3.2 Transport by Vessels

7.2.3.2.1 [574.] Packages or overpacks having a surface radiation level greater than 2 mSv/h, unless being carried in or on a vehicle under exclusive use in accordance with Table IX, footnote (a), shall not be transported by vessel except under special arrangement.

7.2.3.2.2 [575.] The transport of consignments by means of a special use vessel which, by virtue of its design, or by reason of its being chartered, is dedicated to the purpose of carrying radioactive material, shall be excepted from the requirements specified in 7.1.6.3.3 para. 566 provided that the following conditions are met:

(a) A radiation protection programme for the shipment shall be approved by the competent authority of the flag state of the vessel and, when requested, by the competent authority at each port of call;

(b) Stowage arrangements shall be predetermined for the whole voyage including any consignments to be loaded at ports of call en route; and

(c) The loading, carriage and unloading of the consignments shall be supervised by persons qualified in the transport of radioactive material.

7.2.3.3 Transport by Air

7.2.3.3.1 [576.] Type B(M) packages and consignments under exclusive use shall not be transported on passenger aircraft.

7.2.3.3.2 [577.] Vented Type B(M) packages, packages which require external cooling by an ancillary cooling system, packages subject to operational controls during transport, and packages containing liquid pyrophoric materials shall not be transported by air.

7.2.3.3.3 [578.] Packages or overpacks having a surface radiation level greater than 2 mSv/h shall not be transported by air except by special arrangement.

7.2.3.4 Transport by Post (579 and 580)

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Annex 2
CORRESPONDENCE BETWEEN IAEA PARAGRAPHS AND UN REFERENCE

IAEA	UN	IAEA	UN	IAEA	UN
101	P 18 - REC	226	1.2.1	401	2.7.7.2.1
102	X	227	1.2.1	402	2.7.7.2.2
103	X	228	6.4.1	403	2.7.7.2.3
104	P 19 - REC	229	X	404	2.7.7.2.4
105	X	230	1.2.1	405	2.7.7.2.5
106	X	231	6.4.1	406	2.7.7.2.6
107	2.7.1.1	232	1.2.1	407	2.7.7.1.1
108	X	233	1.2.1	408	2.7.7.1.2.1
109	4.1.7.1.5	234	1.1.2.1.1	409	2.7.7.1.2.2
110	X	235	1.2.1	410	X
201	2.7.2	236	1.2.1	411	2.7.7.1.3
202	1.2.1	237	1.2.1	412	2.7.7.1.3
203	1.2.1	238	1.1.2.1.1	413	2.7.7.1.4.1
204	2.7.2	239	1.2.1	414	2.7.7.1.4.2
205	2.7.2	240	1.2.1	415	2.7.7.1.5.1
206	1.2.1	241	1.2.1	416	2.7.7.1.5.2
207	1.2.1	242	1.2.1	417	2.7.7.1.5.2
208	1.2.1	243	6.4.1	418	2.7.7.1.6.2
209	6.4.1	244	1.2.1	419	2.7.7.1.8
210	1.2.1	245	1.2.1	501	5.1.5.1.1
211	1.2.1	246	1.2.1	502	5.1.5.1.2
212	1.2.1	247	1.2.1	503	4.1.7.1.3
213	6.4.1	248	1.2.1	504	5.1.3.2
214	1.2.1	301	1.1.2.1.2	505	X
215	1.2.1	302	1.1.2.1.3	506	X
216	1.2.1	303	1.1.2.1.4	507	2.0.3.2
217	1.2.1	304	P 20 - REC	508	4.1.7.1.2
218	6.4.1	305	1.1.2.1.6	509	4.1.7.1.4
219	1.2.1	306	7.1.6.1.1	510	7.1.6.5.1
220	6.4.1	307	7.1.6.1.3	511	7.1.6.5.2
221	1.2.1	308	P 16 - REC	512	7.1.6.5.3
222	1.2.1	309	X	513	7.1.6.5.4
223	1.2.1	310	1.1.2.2	514	7.1.6.5.5
224	1.2.1	311	P 17 - REC	515	2.7.9.1
225	1.2.1	312	1.1.2.3.2	516	2.7.9.2

Key:
REC = ST-1 provision included as a recommendation with the paragraph number indicated.
X = ST-1 paragraph not necessary or already covered in Recommendations.

IAEA	UN	IAEA	UN	IAEA	UN
517	2.7.9.3	555	5.4.1.1.7.2	611	X
518	2.7.9.4	556	5.4.1.1.7.3	612	6.4.1.6
519	2.7.9.5	557	5.1.5.3.2.4	613	6.4.1.7
520	2.7.9.6	558	5.1.5.3.2.4	614	6.4.1.8
521	4.1.7.2.1	559	5.1.5.3.2.4	615	6.4.2.9
522	4.1.7.2.2	560	5.1.5.3.2.4	616	6.4.2.10
523	4.1.7.2.3	561	5.1.5.4.1	617	6.4.3.1
524	4.1.7.2.4	562	X	618	6.4.3.2
525	7.1.6.2	563	7.1.6.1.2	619	6.4.3.3
526	2.7.6.1.1	564	7.1.6.3.1	620	6.4.4
527	2.7.6.1.2	565	7.1.6.3.2	621	6.4.5.1
528	2.7.6.2.1	566	7.1.6.3.3	622	6.4.5.2
529	2.7.6.2.2	567	7.1.6.3.4	623	6.4.5.3
530	2.7.8.1	568	7.1.6.4.1	624	6.4.5.4.1
531	2.7.8.2	569	7.1.6.4.2	625	6.4.5.4.2
532	2.7.8.3	570	7.2.3.1.1	626	6.4.5.4.3
533	2.7.8.4	571	7.2.3.1.2	627	6.4.5.4.4
534	5.2.1.5.1	572	7.2.3.1.3	628	6.4.5.4.5
535	5.2.1.5.2	573	7.2.3.1.4	629	6.4.6.1
536	5.2.1.5.3	574	7.2.3.2.1	630	6.4.6.2
537	5.2.1.5.4	575	7.2.3.2.2	631	6.4.6.3
538	5.2.1.5.5	576	7.2.3.3.1	632	6.4.6.4
539	5.2.1.5.6	577	7.2.3.3.2	633	6.4.7.1
540	5.2.1.5.7	578	7.2.3.3.3	634	6.4.7.2
541	5.2.2.1.11.1	579	X	635	6.4.7.3
542	5.2.2.1.11.1	580	X	636	6.4.7.4
543	5.2.2.1.11.2	581	X	637	6.4.7.5
544	5.2.2.1.11.3	582	7.1.6.5.1	638	6.4.7.6
545	5.2.2.1.11.4	601	2.7.3.3	639	6.4.7.7
546	5.3.1.3.2	602	2.7.4.1	640	6.4.7.8
547	5.3.1.3.3	603	2.7.4.2	641	6.4.7.9
548	X	604	2.7.4	642	6.4.7.10
549	5.4.1.1.7.1	605	2.7.10.1	643	6.4.7.11
550	X	606	6.4.2.1	644	6.4.7.12
551	X	607	6.4.2.2	645	6.4.7.13
552	5.4.1.1.7.3	608	6.4.2.3	646	6.4.7.14
553	X	609	6.4.2.4	647	6.4.7.15
554	X	610	6.4.2.5	648	6.4.7.16

Key: [ ] = Potential general definition, but redrafting work necessary.
x = ST-1 paragraph not necessary or already covered in Recommendations.

IAEA	UN	IAEA	UN	IAEA	UN
640	6.4.7.8	678	6.4.11.8	734	6.4.12.2.22
641	6.4.7.9	679	6.4.11.9	735	6.4.12.2.23
642	6.4.7.10	680	6.4.11.10	736	6.4.12.2.24
643	6.4.7.11	681	6.4.11.11	737	6.4.12.2.25
644	6.4.7.12	682	6.4.11.12	801	5.1.5.4.2
645	6.4.7.13	701	2.7.3.4; 6.4.12.1	802	5.1.5.4.1
646	6.4.7.14	702	2.7.3.4. 6.4.12.1.2	803	6.4.13.5
647	6.4.7.15	703	2.7.3.5	804	X
648	6.4.7.16	704	2.7.4.4	805	P26-REC, 6.4.13.1
649	6.4.7.17	705	2.7.4.5	806	6.4.13.2
650	6.4.8.1	706	2.7.4.5	807	P24 - REC
651	6.4.8.2	707	2.7.4.5	808	X
652	6.4.8.3	708	2.7.4.5	809	6.4.13.3
653	6.4.8.4	709	2.7.4.6	810	P25 - REC
654	6.4.8.5	710	2.7.4.7	811	X
655	6.4.8.6	711	2.7.4.8	812	6.4.13.4
656	6.4.8.7	712	2.7.10.2	813	P27 - REC
657	6.4.8.8	713	6.4.12.1.3	814	X
658	6.4.8.9	714	6.4.12.2.2	815	6.4.14.1
659	6.4.8.10	715	6.4.12.2.3	816	6.4.14.2
660	6.4.8.11	716	6.4.12.2.4	817	6..4.14.3
661	6.4.8.12	717	6.4.12.2.5	818	6.4.14.4
662	6.4.8.13	718	6.4.12.2.6	819	P35 - REC
663	6.4.8.14	719	6.4.12.2.7	820	5.1.5.2.2
664	6.4.8.15	720	6.4.12.2.8	821	5.1.5.2.2
665	6.4.9.1	721	6.4.12.2.9	822	P22 - REC
666	6.4.9.2	722	6.4.12.2.10	823	X
667	6.4.10.1	723	6.4.12.2.11	824	see 1.1.2.3.2
668	6.4.10.2	724	6.4.12.2.12	825	P23 - REC
669	6.4.10.3	725	6.4.12.2.13	826	X
670	6.4.10.4	726	6.4.12.2.14	827	P21 - REC
671	6.4.11.1	727	6.4.12.2.15	828	P29 - REC
672	6.4.11.2	728	6.4.12.2.16	829	P30 - REC
673	6.4.11.3	729	6.4.12.2.17	830	P31 - REC
674	6.4.11.4	730	6.4.12.2.18	831	P32 - REC
675	6.4.11.5	731	6.4.12.2.19	832	P32 - REC
676	6.4.11.6	732	6.4.12.2.20	833	P34 - REC
677	6.4.11.7	733	6.4.12.2.21	834	P36 - REC

Key: [ ] = Potential general definition, but redrafting work necessary.
x = ST-1 paragraph not necessary or already covered in Recommendations

Annex 3

Consequential changes to UN Recommendations, 10th Revised Edition

Recommendations on the Transport of Dangerous Goods

Add text in Annex 1, revise Table of Contents accordingly

Chapter 1.1

Delete 1.1.2, replace with proposed new text.

Chapter 2.7

Delete 2.7.1, replace with proposed new text.

Chapter 3.2

For the information to be indicated for each Class 7 substance see the attached table.

Chapter 3.3

Delete special provisions 172 and 285.

Chapter 4.1

Delete 4.1.7 and replace with the text in Annex 1.

Delete 4.2.1.15.1 and renumber 4.2.1.15.2 and 4.2.1.15.3

Chapter 5.1

Add text as shown in Annex 1.

Chapter 5.2

Delete 5.2.15, replace with the text in Annex 1.

Add new 5.2.2.1.11 as shown in Annex 1.

Delete the first sentence in 5.2.2.2.1.6.

Chapter 5.3

Delete paragraph *number* only 5.3.1.2.1.

In first line of 5.3.1.2, amend '5.3.1.2.2' to '5.3.1.3'

Add new section heading:
"5.3.1.3 Placards for Class 7"

Renumber 5.3.1.2.2 as 5.3.1.3.1 and delete all but the first sentence.

Chapter 5.4

Delete 5.4.1.1.7, replace with proposed new text.

In 5.4.1.1.11 amend as shown in Annex 1.

Delete 5.4.3.4.

Part 6

Add a new Chapter 6.4 as shown in Annex 1.

Chapter 7.1

Delete 7.1.6, replace with proposed new text.
Add new 7.2.3, as proposed.